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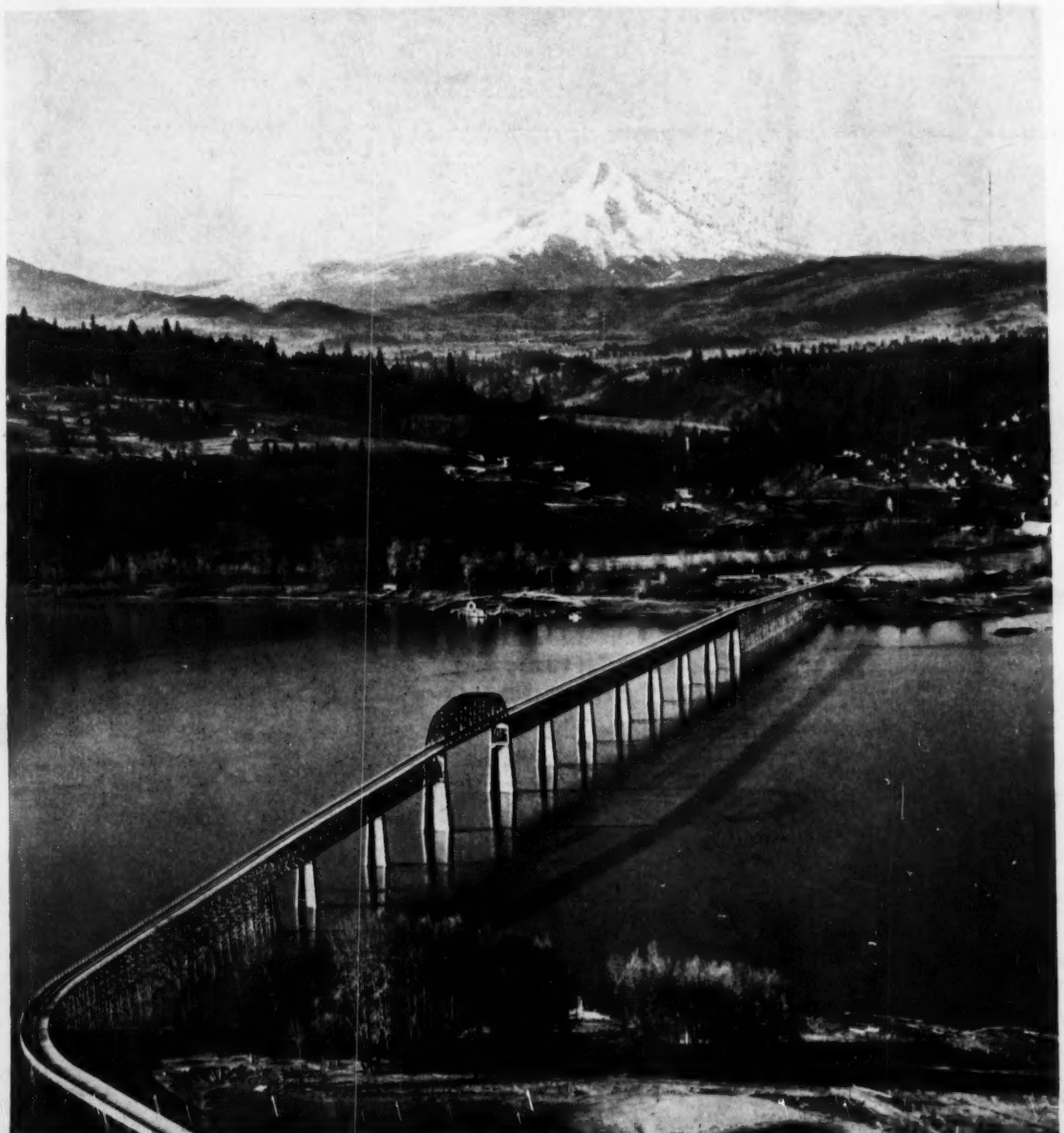
April 30, 1925

Engineering News-Record



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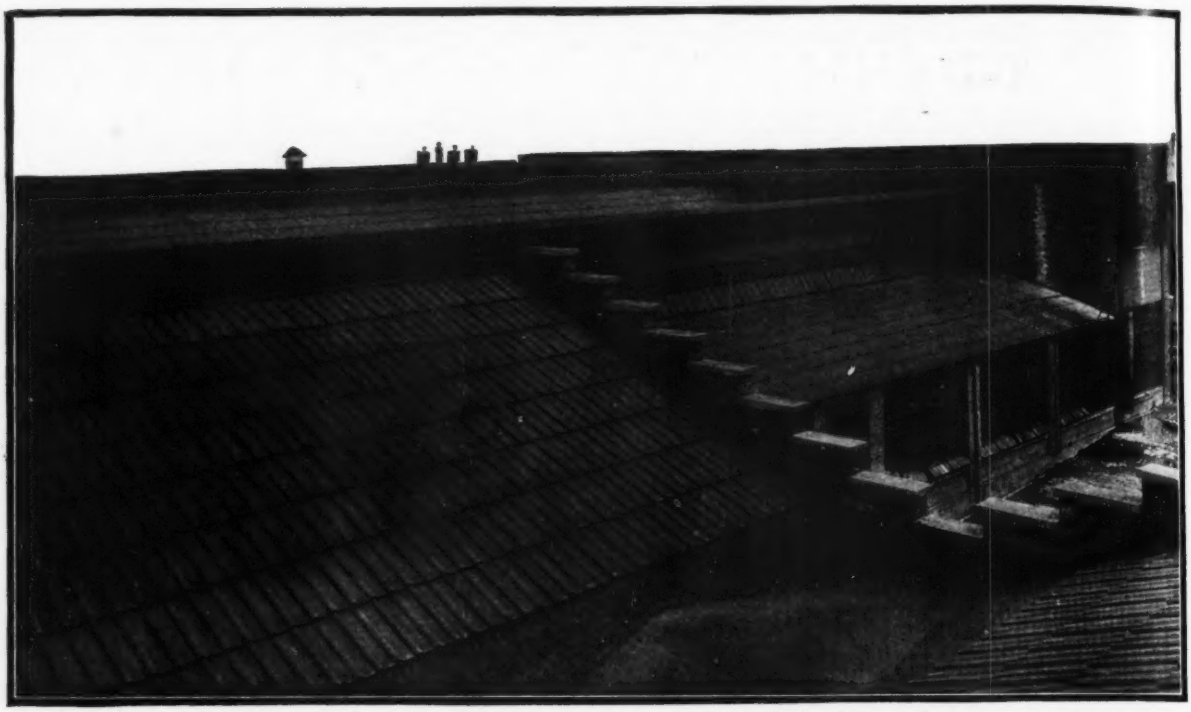
New Jersey Plans Arterial Road from Holland Tunnel—Building Wilson Dam at Muscle Shoals-Part II—Port of Manila Opens Large Shipping Pier Safeguarding Long Highway Bridge from Fire

Bridge Over the Columbia River at Hood River, Ore.—Mount Hood in Background



Buick Motor Company's foundry at Flint, Mich., roofed with Federal Interlocking Tile; Federal Flat Slabs in gutter.

A decade of service has left this Federal Roof unscathed

A dozen or fifteen years do not comprise a very long moment in the history of the universe but in the life of a roof they mean a great deal. In that length of time it becomes apparent whether a roof will stand the gaff or not. Most modern roofs will. Federal Roofs stand it to the point of practical permanence. They last as long as the structures they crown.

As an example, the roof of the Buick Motor Company's foundry at Flint, Michigan, shown above, has been in service ten years. The fact that it is as good today as the day it was erected speaks volumes for Federal Cement Tile. It shows no wear now and will show none after ten years more.

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 94 NEW YORK, APRIL 30, 1925 Number 18

Five Dollars a Minute

THE other day one of the men in charge of the big suspension bridge across the Delaware at Philadelphia remarked to a visitor—"Every fifteen minutes in this wire stringing operation is worth $80." There's a text for an engineering sermon in that casual statement. It italicizes the importance of the overhead; it emphasizes the significance of delay; it makes tangible the necessity for continuity of operation. Few engineering jobs run into such big figures as this one and few have operations which can be so readily reduced to unit time costs as the weaving of the cables of a suspension bridge, but the general conditions are the same on every job. It would be well if every engineer and every construction man kept in mind a few unit time figures so that he would realize just what every delay and every slow-up meant in actual dollars and cents.

A Shipping Pier De-Luxe

MANILA can show the continent of the United States something in the design and construction of the magnificent new shipping pier described in this issue. Whether or not there is business enough in the port to warrant such expenditure is doubtful, but certainly purely as an engineering solution, both as to structure and operation, the pier is memorable. It shows the influence of the West Coast in the wide pier space and of Europe in the elaboration of the handling machinery. Being a world port, with shipping from everywhere, this latter is a precaution that has not been held so necessary in the Eastern United States, especially in New York where the shipping is largely engaged in oceanic ferry service and is itself equipped with handling machinery. However, where Manila has gone the whole way toward mechanizing the pier, New York probably does not go far enough. Our Atlantic ports can learn from this Far Eastern one. In next week's issue, the other outstanding feature of the Manila pier, the use of 110-ft. reinforced-concrete piles, will be described. These are record units, and both their design and the remarkable piledriver with which they were placed are matters of interest.

A Triumph of Law

LAST week the Philadelphia Department of City Transit awarded a contract for approximately $17,000,000 to a bidder who was $113,000 higher than the low bidder because the latter submitted as evidence of good faith a certified check $12,500 short of the $837,500 required as five per cent of the total bid. And the city department was justified in its action by the Supreme Court of the state to whom the case had been brought for decision. Thus the law has been vindicated and justice in the future possibly insured at the expense to the city of over $100,000 and to the losing contractor of one of the biggest construction jobs ever let in one piece. The oversight by the losing contractor can hardly be condoned; the "instructions to bidder" specifically stated that the certified check should cover the total of $300,000 added by the city for "force account" plus the percentage bid by the contractor as his fee for that force account work. Nevertheless, the ruling of the court demonstrates the severity of the law, for the losing contractor is admitted by all not only to be fully qualified by experience and reputation but also able to furnish the full required certified check and in fact did so as soon as notified that an addition was expected. Further than that he had bid only 15 per cent profit on the force account work, while his successful competitor had bid 30 per cent—and the force account sum will probably turn out to be much more than the $300,000 prescribed. The lesson is that all contracts and instructions must be read with most meticulous care especially when so curious and debatable an expedient as the Transit Commission's provision for "force account" is included. Besides that, verified instructions should be requested by the contractor on any description that is not crystal clear.

Ready to Study the St. Lawrence

IT TOOK almost a year for the governments of the United States and of Canada to agree on what the engineers of the two countries should investigate in preparation for a new Great Lakes and St. Lawrence treaty. The diplomatic correspondence during that period, abstracted on another page of this issue, shows that all the delay was due to sparring over the status of the existing diversions from the Great Lakes system, in preparation for the discussions inevitably to arise as to these diversions when the treaty itself comes to the conference table. Canada wants the Chicago diversion held up to obloquy but prefers not to talk about the fact that her power plants are taking nearly twice as much water as ours at Niagara, and she was at first unwilling even to have an engineering study of the Niagara situation made. The final "instructions" preserve more the Canadian than the United States view, but our Department of State has fully protected the future negotiations, and has insured that when the time comes Niagara will be as much a matter of interest to the treaty commissioners as Chicago. This is as it should be, for the two are of co-ordinate importance and almost coincident authorization. It happens that public sentiment in Canada has been systematically inflamed as to the Chicago case to the point where even fairminded Canadian negotiators have difficulty in considering it judgmatically, though there has been nothing in the conduct of the United States government that would lead anyone, in Canada or elsewhere, fairly to doubt this government's honest intention to settle the Chicago case justly to all parties concerned, Canada included. However, now that the diplomats are through making language and laying the groundwork for future wordy argument, the engineers will be able to get together in customary amity and find out a few of the facts about the St. Lawrence and the Great Lakes.

An Impasse in New York's Port

SOMETHING greater than the feasibility of the Narrows tunnel between Staten and Long Islands was at issue in the decision made last week by Governor Smith to approve the Nicoll-Hofstadter Act requiring the city of New York to divest that prospective tunnel of its present freight carrying provision. The old fight of the present city authorities against the whole plan of the interstate Port Authority was brought to a head and once more the Port Authority triumphed. One more move has been made in the long struggle for dominance in the New York port district, a struggle born of the bi-state occupancy of the harbor. Much has been said of the engineering significance of that struggle, but the fact has only once more been emphasized that in this dispute engineering is but the handmaiden of policy—sometimes misnamed politics—and not the mistress of the situation.

There is little doubt that were it possible to conceive of the metropolitan area of New York under control of some benevolent despot he would find small difficulty in establishing a consensus of engineering opinion as to the proper procedure to follow in developing the transportation needs of his kingdom. But when other than engineering considerations govern, when the jockeying for position or control is in the hands of the local administrations, the engineer's advice and opinion is called in only to answer certain categorical questions on the practical operation of plans decided upon primarily for other than the engineering principles involved.

Such has been distinctly the case with the Narrows tunnel, and its connection with the great plans for the development of New York harbor. That tunnel has been only a pawn, or perhaps better a knight, in the chess game between the city and the Port Authority. The city, at least the Hylan administration of the city, has been continuously opposed to the Port Authority, both in principle and as authorized by the law and agreement of the two states. It has not only opposed the idea of any control of the harbor of New York by a body outside the control or influence of the city administration but it has opposed the specific methods of developing the port facilities which have become a part of the organic act forming the Authority. It long ago became apparent that so long as the city administration was of that view, and the Port Authority remained firmly bound to its present form and its present plan, that progress in the development of the port was impossible, or at least painfully slow.

A part of the formal plan of the Authority is the transbay tunnel from Bayonne to Brooklyn, and the stub-ending of Staten Island in the port's railway scheme. But in Staten Island the city has a tremendous undeveloped area of great potentiality and, what is important as a matter of present interest, a $30,000,000 investment in shipping piers started in the enthusiasm of war shipping and now isolated and vacant. A Narrows tunnel would not only open up those piers to both west and east, but would, if started before the Authority could get its transbay tunnel opened, make that tunnel unnecessary. At the same time Staten Islanders clamoring for rail connection to the mainland could be appeased by the promise of passenger service, which while specifically stated to be only equal to the less excellent of the commuting services in the New York district might be interpreted by the laity, and exploited by the realty interests, as rapid transit.

We are far from denying that from the city's narrow point of view this was good strategy. An excellent case for the superiority of the Narrows tunnel can be built up if it is admitted that the State of New Jersey has no interest in the port of New York and cares nothing as to the location and number of connecting rail-lines and classification yards within its borders designed specifically to promote the commerce and industry of New York. But the State of New Jersey, by solemn compact with its sister state, has been granted the privilege of equal jurisdiction over the interstate freight connections. New York City, therefore, cannot expect New Jersey to sit back and take whatever arrangement of railways the city's experts deem most efficient; it has equal rights which must be observed. The city's procedure, as the governor points out, must look toward revision of the terms of the compact, and not be in defiance of it.

It is difficult to take seriously all the to do over the joint operation of the tunnel for freight and passengers. The city, in contravention to normal municipal desires, is primarily interested in freight movement; on its own testimony the passenger feature is merely temporary. Of course freight and passenger cars can be operated through the same tunnel; it is being done every day in countless tunnels everywhere. But the nice co-ordination of freight classification and scheduling to permit a million tons a month to filter through sixty passenger trains a day is something few engineers or railway operators would care to undertake unless forced to do so by the most exigent conditions. And sixty passenger trains a day is a very poor imitation of rapid transit.

The whole situation is a rather lamentable commentary on the efficiency of our organized society. Both the city and those behind the Port Authority idea are trying to serve the best interests of the community as they see it, but they both seem to lack the capacity of compromise. Staten Island needs industrial development and easy passenger communication. It might get the first by the city's scheme but it will get the second neither by the city's scheme nor by the proposition of the Nicoll-Hofstadter Act, which merely provides that the Staten Islanders will be set down somewhere in the hinterland of Brooklyn, there to find their way to their desired destination in Manhattan by already overcrowded subways. The Port Authority, on the other hand, has been formulated as a superior political body, responsible to no one and responsive to no one, and bound hand and foot by a rigid physical plan, which presupposes that all the engineering and transportation intelligence of the next twenty-five years must bow to those who conceived the plan of 1921. No such assumption of a monopoly of brains has been made since the Federalists laid down the Constitution.

The freight handling situation in New York harbor has thus reached an impasse. The city, which would have spent $60,000,000 to open up a tunnel connection between two of its boroughs solely on the chance that the railroads would be forced to use it (and pay for it), is blocked by the state. The interstate body has made no constructive move whatever in the three years of its existence toward a physical remedying of the admittedly expensive and unscientific system of freight handling now in force and it is becoming more and more doubtful whether it ever will be able, lacking New York City co-operation, to carry through even a small part of the elaborate "comprehensive plan" which it laid out

for the next quarter-century. The railroads meanwhile, forced by lack of funds, the impossibility of extensive new financing and the temper of the legislatures and the people favoring governmental financing and construction of what once was purely a matter of private initiative, sit back like Micawber and wait for something to turn up.

The solution is difficult to foresee. The unprejudiced observer would say that the city's ambitions for Staten Island should be recognized by the Port Authority to the extent of modifying its plan and working out a marginal railway from yards in New Jersey through Staten Island to Long Island. The economies of such a line are just as arguable as those for the Authority's northerly line and tunnel. In its turn the city should forego its private ambitions to control the harbor and lend its efforts to the more immediate and necessary job, that of providing Richmond Borough with real, not pseudo rapid-transit. A tunnel straight from St. George to the Battery is not beyond the bounds of possibility to a city that would spend $60,000,000 on the chance that a customer can be found and has spent $30,000,000 on the magnificent adventure of the Stapleton piers.

That is the common sense of the situation. We shall see in the years to come how much of that rare quality exists in the group consciousness of a community of 10,000,000 souls.

Engineers Not Yet Awake

WORLD-WIDE interest in city planning was shown by the six hundred American and foreign delegates who took part in the city and regional planning conference held in New York last week, but though many engineers were present, they and their methods of attack were so subordinated to what might almost be termed the emotional appeal of city planning that one must conclude that as a class engineers are not yet awake to their duties and opportunities in this field.

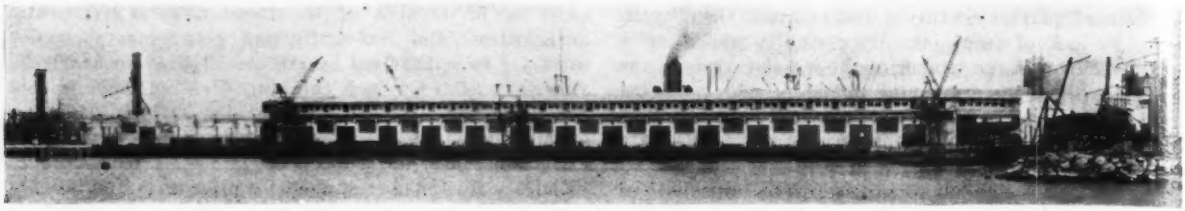
Engineers possibly have not sensed the ever broadening significance of the movement. Concerned originally with cities it was not long before it was seen that planning for orderly growth could not stop at the city line without having to encounter lack of planning outside the city boundaries, especially as annexations took place. The first attempt to meet this problem was to extend the city plan a few miles outside the city limits, even though as a rule there was no legal authority for doing so. Not many years elapsed before regional planning came to the front. Last week's conference, devoted largely to regional planning, went beyond it to include serious mention of state planning. A plan for the State of New York, for instance was the subject of one of the papers and a delegate from Vermont, a state with few and small cities, boldly maintained that state planning is needed in that commonwealth. Already regional planning does not stop at state lines, for the regional plan for New York and environs, on the engineering side of which the late Nelson P. Lewis did much work, includes parts of three states—some 400 political subdivisions in New York, New Jersey and Connecticut. Nation planning will come next—and break down by its own weight, some skeptic may say. It has indeed already come, as was outlined for Mexico by a delegate from that country.

These ambitious and far-flung schemes require that the planners, even more than in the planning of cities, must be in advance of the responsible governmental authorities. Political units and governmental bodies must yet be authorized by statute, at least in nearly all American states. Such thinking does not come within the traditional engineering purview, which doubtless explains why the engineer, barring a few well known exceptions, has not concerned himself with planning policies. Such policies and the programs that accompany them too frequently come under the head of dreams, and while the engineer is a dreamer, he is a practical dreamer, one more concerned with making his dreams come true than in elaborating them for the sheer pleasure of dreaming. Too much city planning has been in the latter class; much of it was evident at this New York meeting. It behooves engineers to concern themselves more with the men who are doing this pointless dreaming and to try to get them back a little nearer to earth.

In the matter of traffic control, particularly, can the engineering view be helpful. Traffic control is transportation management and that is distinctly an engineering job. At this meeting, however, as at the Hoover traffic safety conference last fall, the engineer was subordinated to the inexpert, who either have projected themselves so far into the future as to consider all traffic problems solvable only by property transformations so expensive as to be the work of a half-century or, on the other hand, are so close to the present as to see only proper police supervision as the cure. General solutions of the traffic evil are not possible. Always it is distinctly a local problem, and for its solution the properly trained engineer has the best answer, if he will stick to the sound engineering principle that the primary necessity in any new scheme or plan is to make sure that it works. Beautiful pictures of arcaded streets and wide boulevards through billion-dollar realty will not take a truck off a congested street. But engineering studies of existing routes can be coupled up to a sensible campaign of education which may get those trucks off to other routes within a month. This the engineer can do, while the landscape artist and social worker is thinking about Utopia.

Probably the conference, with its many papers and eager discussions, was fruitful. A goodly number of engineers were present—the ratio of engineers to planners from the ranks of the landscape architects has been steadily growing from the time of the first American conference. Although the vision of this larger group is broadening most of its members need to look much farther afield than they yet do. Had engineers as a class grasped this idea fifty or a hundred years ago we should have comprehensive instead of inarticulated city planning from the very inception of thousands of cities and villages of haphazard growth. It is unjust, however, to lay on the engineers all the blame for lack of comprehensive planning, as anyone can appreciate who realizes the meager authority or even influence that is accorded to engineers in the making of policy in American municipal government. The lawyer's hand appears everywhere in the framework and administration of cities. He drafts and interprets city charters. The engineer does the work.

Comprehensive planning has become so prevalent in our cities and has taken such a real range and subject scope that a change is imperative. The engineer should wake up to the demands the situation makes on him. A much despised practicality is called for. Let's get some of these fine ideas to work.



Port of Manila Opens Large Shipping Pier

Newest Addition to Modernization of Philippine Island Port Is Wide and Long Structure on Record Size Concrete Piles and Fully Equipped with Cargo Handling Machinery

By E. C. Earle
Chief Designing and Port Works Engineer, Bureau of Public Works, and Vice-President, Manila Harbor Board, Manila, P. I.

[This is the first of two articles by Mr. Earle on the new pier at Manila; the second one will describe in detail the methods of casting and driving the reinforced-concrete piles, which were precast of record size, 24 in. square and 110 ft. long, and driven by a remarkably large machine.—Editor.]

CONSTRUCTION of the new pier (Pier 7) at Manila is the first of several projects which the Insular Government plans to carry out in connection with the proposed program for the improvement of the Port of Manila, which includes the construction of two new modern piers, the reconstruction and enlargement of existing piers, the construction of marginal wharves, cargo sheds, an oil and coal depot, the extension of the breakwater, etc., including the deepening of the harbor to 40 ft. in the South Port District.

General Description of Pier—The new terminal structure is 234 ft. wide and its length when completed will be 1,400 ft. It is equipped throughout with modern mechanical facilities for the rapid handling of a miscellaneous cargo. The pier shed proper is 160 ft. wide and 1,253 ft. long. Aprons, 36 ft. wide, extend out on each side to the fender system. Railway tracks are being provided on each apron. The general layout of both cargo and passenger decks is shown in Fig. 1.

A novel feature incorporated in the design of the structure is the overhead passageways situated on both sides of the pier for handling passengers. The usual exposure of passengers to risks encountered in passing through the more or less dangerous areas utilized for trucking, storage and handling of cargo is completely avoided on this pier. Ships' decks are reached by ascending stairs or using elevators situated within the pierhead on both sides of the waiting room, and by them passing through either the north or south passageway and over the connecting bridge to the ships' decks.

Features of Design

Novel features for caring for passenger traffic embodied in structure.

Special interior and exterior electric cargo handling equipment.

Roof trusses of long span designed to carry interior cargo handling cranes from suspended runway—maintaining large clear floor space on cargo deck of pier.

Wide apron provided to handle cargo over.

Unique fender system equipped with heavy buffer springs.

Features of Construction

Concrete piles 24 in. square, 110 ft. long, weighing 32 tons and driven to sustain 100-ton loads. Largest and most powerful floating piledriver ever constructed required to drive the piles.

Special field equipment used for casting, lifting and transporting piles.

The floor system throughout the pier is of concrete and of the slab and girder type. All walls and columns are also of concrete. The roof over the main shed is of galvanized iron—supported by steel trusses, while the roof over the passageways at the second floor level is of tile on steel trusses.

The shed is well ventilated and lighted by continuous top-hung movable steel sash running the entire length of the structure and electrically operated, while fixed steel sash lights every alternate panel of the shed wall. Steel rolling doors 18x20 ft., both electrically and manually operated, have been installed in alternate panels of the shed wall, with provision for inside and outside control.

The fender system, built entirely of a local timber known as mountain dungon, which is highly resistive to the ravages of marine borers of these waters, is supported by and slides on heavily reinforced concrete brackets. Large spring pots, each fitted with two heavy double-coil springs capable of resisting 50 tons per set when fully compressed, are located above and below each bracket (Figs. 5 and 6).

The pierhead consists of a three-story central building and two entrance wings; the latter simply form a covered connection between the pier shed, the pierhead and the adjacent cargo sheds or laterals. Waiting rooms, baggage room, custom and other offices are located in the central portion of this building.

Cargo-Handling Facilities—The mechanical equipment for the rapid handling of cargo on the pier will consist of 16 electric traveling semi-portal gantry

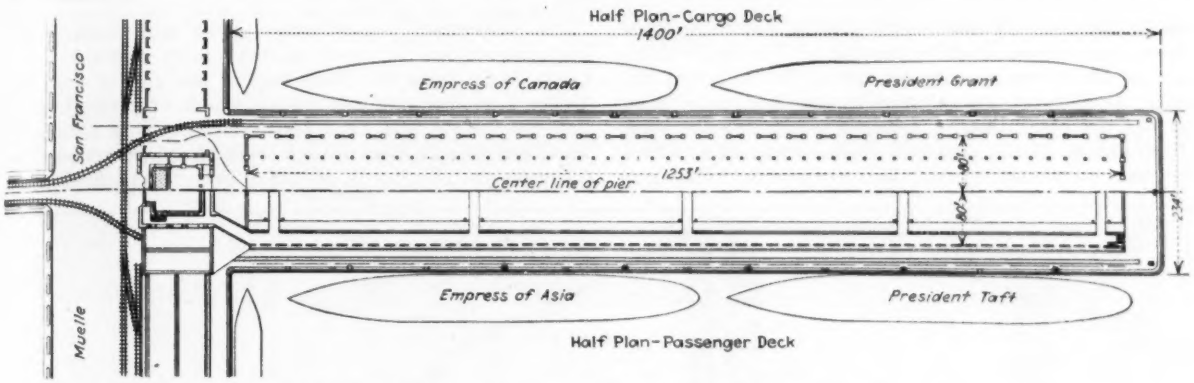


FIG. 1—PLAN OF MAIN AND PASSENGER DECK OF NEW PIER 7, PORT OF MANILA, P. I.

cranes of the jib type (fourteen 2-ton and two 15-ton) 8 being situated on each side of the pier; a flexible system of 48 interior 2- and 3-ton overhead electric cranes; a fleet of industrial tractors, trailers and elevating trucks, and other usual auxiliary equipment such as portable conveyors, stackers, etc. Six gantry and 24 interior cranes have already been installed.

Substation Illumination—Current for the operation of all cranes and other cargo-handling machinery as well as for illumination is brought to the substation at the center of the pier at 3,300 volts. Here it is stepped down through a battery of transformers to 160 volts (for cranes) and is then converted by synchronous converters to direct current and put on the feeders at 260 volts. Two 350-kva. synchronous converters take care of the present loads; however, the complete installation for pier service will consist of four machines of this capacity.

Special care has been taken to provide excellent illumination for the operation of the pier at night, as the efficient handling of a miscellaneous cargo with rapid electric cranes and other cargo-handling equipment depends, to a great extent, upon proper lighting. Standard lighting units have been distributed so as to give an almost uniform intensity of approximately 2½-ft. candles throughout the shed.

Condition Governing Design of Pier—As by far the greater bulk of import cargo handled over Manila piers is destined for go-downs or warehouses in various parts of the city not served by direct rail or water connection, such cargo must pass over the apron and into the pier shed, whence a large percentage is removed by industrial tractors and trailers to the adjacent cargo sheds or laterals for classification and delivery. In view of this and the fact that eight per cent of all export cargo is loaded aboard ship directly from barges alongside, it was deemed advisable to avoid depressed trackage, and rails have accordingly been set flush with the apron block surface. Greater latitude was thus obtained for the disposition of each draft of cargo upon the apron whence it is rapidly removed by stevedores' hand trucks or directly deposited upon industrial trailers or elevating platform trucks.

The large quantities of hardware such as wire, spikes, galvanized roofing sheets, steel plate and other heavy materials like paint and print paper, arriving at the port of Manila, led to the decision to design for rather heavy live-loads to obtain maximum service from the structure; accordingly, 1,000 lb. per sq.ft. was used in designing the floor system within the shed and 750 lb. per sq.ft. for the aprons. Special provision was made in the design of the apron to care for the heavy reactions of the traveling gantry cranes and the freight locomotives.

Within the shed a special effort was made to avoid obstructing the cargo deck with numerous columns

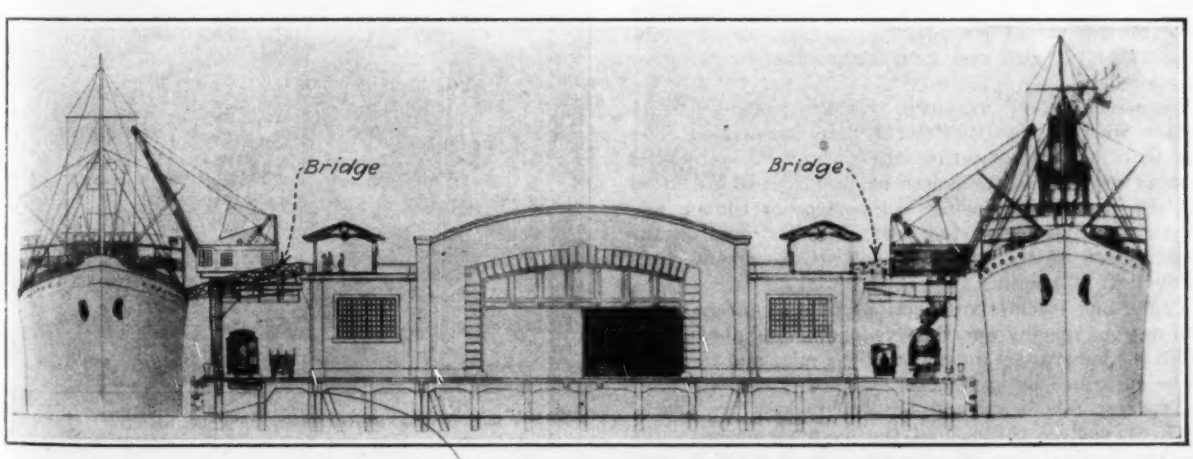


FIG. 2—ELEVATION OF SHORE END OF PIER SHED OF PIER 7 AT MANILA
Section taken between pier head and shed.

and to this end long span trusses (96 ft.) were designed to support suspended crane runway girders, thus doing away with a line of columns down the center of the pier. Aside from the columns in the shed walls there are but two other lines of columns supporting the shed, all spaced on 22 ft. centers. This arrangement offers the maximum unobstructed floor space and at the same time permits the very convenient division of the shed structure into four crane bays.

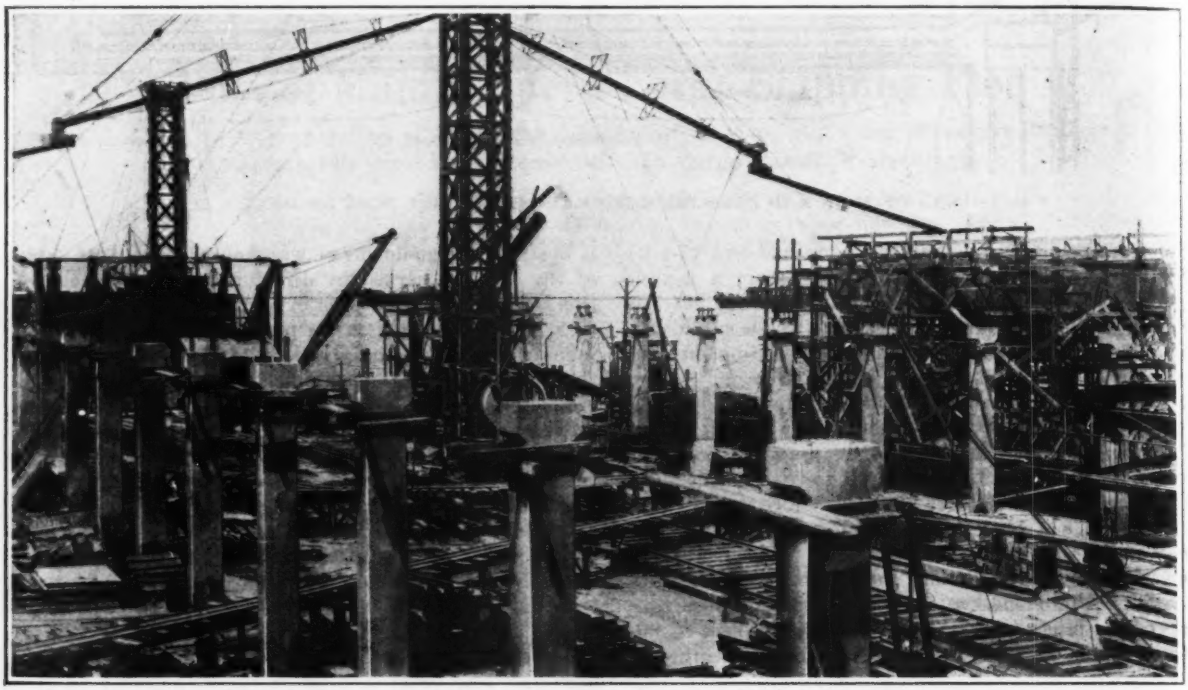


FIG. 3—GENERAL VIEW OF CENTRAL MIXING AND CHUTING PLANT MOUNTED ON STEEL CARS
This plant advanced down the center of the pier as the work progressed.

Design and Arrangement of Piled Substructures—The design of the substructure was based upon the results of a thorough exploration and study of the underlying material of the harbor bottom, and upon results obtained by driving test piles at intervals over the area of the pier site. A 2-in. core-drill, motor-driven, was used in making borings. The materials encountered varied considerably throughout the site. About 20 ft. of stiff blue mud overlay the several other strata.

Permanency and resulting rigidity considered together with the possibilities of faster operation were the main factors dictating the use of concrete piles instead of concrete cylinders or in place of the usual concrete-filled steel casings supported on timber pile clusters; the latter system was formerly used in the construction of the earlier Insular Government piers at the port of Manila.

Crane and locomotive reactions on the aprons, door and column spacing and the live-loads noted above indicated the general arrangement of the piles and the loads to be sustained by each.

Traverse pile bents and fender brackets are spaced on 11-ft. centers throughout the main structure, while the longitudinal lines of piles are spaced on 16-ft. centers under the shed and on 13- and 18-ft. centers under the aprons.

The outermost row of piles under each transverse bent are driven in pairs as they must sustain very heavy loads from the front legs of the gantry cranes. Under each shed and wall column a pair of vertical piles and one batter pile have been driven. This arrangement requires 25 piles in each transverse bent under the columns and 17 piles in all other bents. The load sustained by an individual pile varies from 90 to 108 tons. These loads necessitated the use of piles having a cross-section 24 in. square.

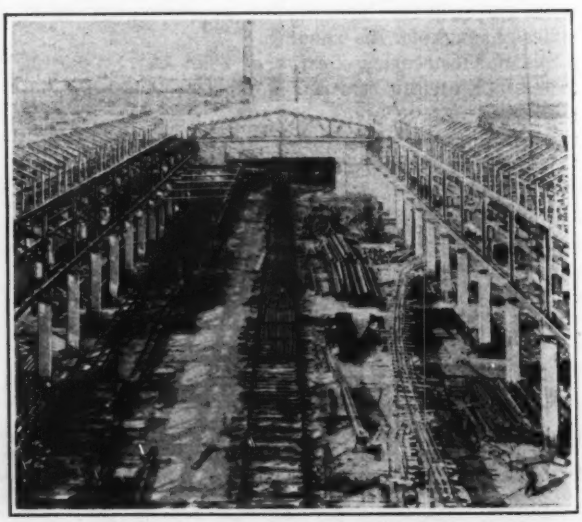


FIG. 4—CONSTRUCTION OF PIER SHED
View illustrates large pier deck space in center of shed.

Piles of a considerable variation in length were required; the longest or 110-ft. piles being driven on the

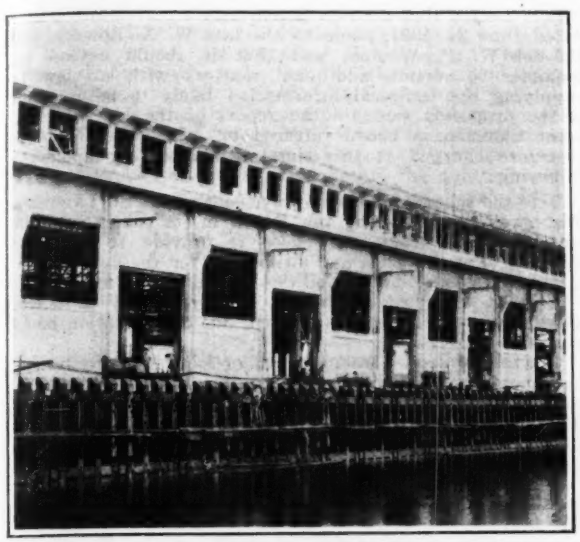


FIG. 5—SIDE ELEVATION OF PIER SHED, PIER NO. 7, MANILA, P. I.

Passenger runway at top where windows are shown. Fender construction under way.

inshore end of the pier and as far out as 400 ft. From this point on to a distance of 800 ft. from shore 90- and 100-ft. piles were driven to grade. The longer piles (110-ft.) were used for the remaining length of the structure, but at a distance of approximately 300 ft. from the offshore end they were driven from 10 to 30 ft. below grade with a follower. Precast pile sections, belled out at the bottom, were set over these piles and grouted in place under air pressure. The very peculiar condition of the harbor bottom at the extreme offshore end of the pier necessitated a greater penetration of piling than was required over any other portion of the site. This was due to the fact that the several thicker strata of harder materials covered most of the area and offered fairly good frictional resistance, pinched out at the end to relatively thin layers offering fair lateral support but insufficient frictional resistance. Accordingly, the piling had to be driven farther and into harder materials existing at greater depths.

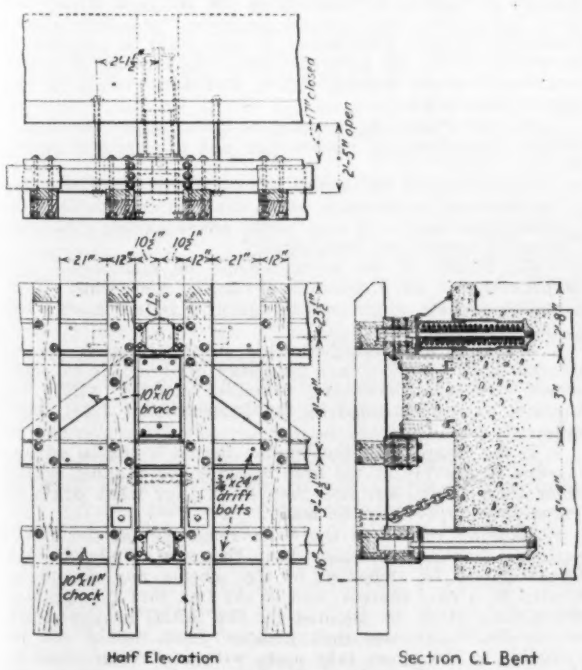


FIG. 6—DETAILS OF FENDER SYSTEM ON MANILA PIER 7

Construction Plant—A provisional wharf and convenient land plant was constructed adjacent to the pier site, for casting piles and for building the floating equipment consisting of a mammoth piledriver, eight 150-ton material barges, a 500-ton pile barge, two test barges and other floating equipment such as derricks.

Concreting of the superstructure is carried on from a central mixing tower and chuting plant equipped with two 1-yd. mixers and a double line of boom chutes mounted on a steel car. As work progressed, the plant was advanced down the center of the pier on rails. A dinky locomotive brought up the aggregate and cement. All batches were mixed 2½ minutes.

All structural steel was assembled and riveted up on the deck of the pier and erected in complete units by the locomotive crane.

Cost—The total cost of the completed pier and pierhead including mechanical cargo-handling equipment will be approximately $4,500,000.

Personnel—The pier was constructed for the Insular Government of the Philippine Islands by the Bureau of Public Works, under the immediate supervision of the writer as chief engineer of the project and Walter J. Grodske as project engineer. Plans for the pier and plant were prepared by the writer and developed under his personal supervision.

FIG. 7—GANTRY CRANES AT WORK ON PIER 7 AT MANILA

Acknowledgment is made of the loyal assistance rendered by Leroy H. Thompson, mechanical engineer, Louis L. Vincent, electrical engineer, Jean M. Allen and Ware Berry, driver superintendent, all of the Bureau of Public Works, Manila.

The gantry cranes were built by the Wellman-Seaver-Morgan Co. while the interior cranes were built by the Shepard Electric Crane & Hoist Co. and by Pawling &

Harnischfeger. The industrial trucking equipment was furnished by the Baker R. & L. Co., of New York.

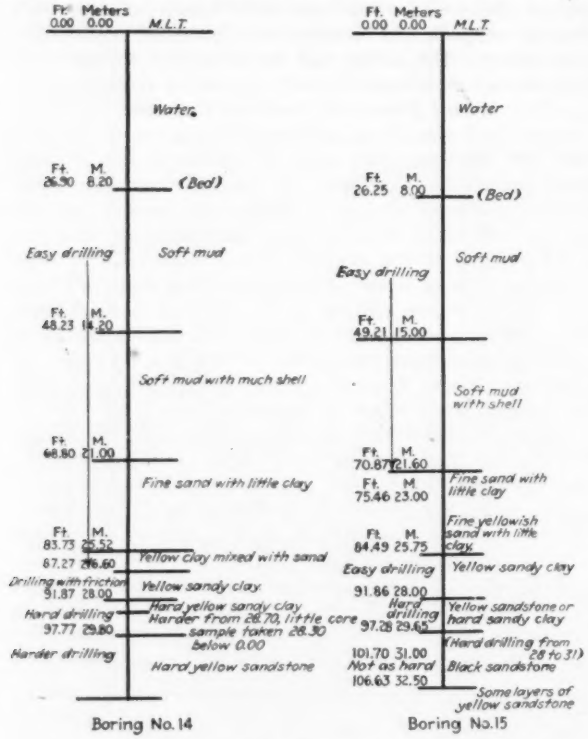


FIG. 8—TYPICAL BORINGS AT PIER 7
Shows why 110-ft. piles were required to carry the pier.

Converters and other electrical equipment in the substation were built by the Westinghouse Co.

St. Lawrence Engineers Instructed on Scope of Work

United States and Canada Agree, After Argument on Niagara Diversion, on What Engineering Joint Board Shall Study

UNDER date of April 23 the governments of the United States and Canada jointly issued instructions to the Joint Board of Engineers on the St. Lawrence Waterway, laying down the basis of the investigations which that board is to make in the coming year and which must be reported to the two governments by April, 1926. These instructions have been under discussion by the two governments since last June, when the two engineering boards met in Montreal and formulated a first draft of the scope of their work. This ten months' delay has been due mainly to an attempt at adjusting the instructions contained in Clause 6 hereinafter noted. There follows the text of the instructions and after that some extracts from the correspondence between the two governments, which explain the nature of the discussions since last June.

Instructions to Joint Board of Engineers on the St. Lawrence Waterway—The Governments of Canada and the United States have accepted the recommendation, made by the International Joint Commission in its report dated Dec. 19, 1921, that the question of the development of the St. Lawrence River for navigation and for the supply of power be referred to an enlarged Joint Board of Engineers.

It is desired that the new Board should review the report dated June 24, 1921, made by the late W. A. Bowden and Colonel W. P. Wooten, and that it should extend its inquiries to certain additional matters with a view to supplying the technical information likely to be relevant to the proposals made in the report of the International Joint Commission above referred to. The new Board is therefore charged at this time with reporting upon the following:

1. Is the scheme for the improvement of the St. Lawrence Waterway, presented by the Board in its report of June 24, 1921, practicable and does it provide to the best advantage, at this time and ultimately, for the development of the capacities and possibilities of the waterway?

2. What alternative schemes, if any, would be better adapted to secure the ends desired, due consideration being given—

(a) to any special international or local interests having an importance justifying exceptional consideration, and

(b) to the extent and character of the damage through flooding and the probable effect of the works upon the formation of ice and the consequent effect on the flow of the river?

3. Should the estimates of cost be revised and, if so, what are the revised estimates of cost having regard to alternative schemes?

4. In order to assist either government to allocate the amounts chargeable to navigation and power, what would be the respective estimated costs for improving the river for navigation alone and for power alone?

5. To what extent may water levels in the St. Lawrence River at and below Montreal, as well as the river and lake levels generally, be affected by the execution of the project?

6. (a) To what extent and in what manner are the natural water levels in the St. Lawrence River and on the Lakes affected by diversions authorized by license by either Canada or the United States, from or in the St. Lawrence River watershed?

(b) By what measures could the water levels or navigable depths affected by the diversions referred to in Section 6 (a) be restored, and what would be the cost thereof?

(c) How much power could be developed on the St. Lawrence River with the water diverted from the watershed referred to in Section 6 (a) under:

(1) The plans recommended.

(2) Alternative plans providing for a full practical development of the river.

(d) Without considering compensation by the present relative diversions of water from the Niagara River and from Lake Erie, and without prejudice to a future consideration thereof, what works, if any, could be constructed to recover on the St. Lawrence River the amount of power determined under Section 6 (c), and what would be the cost of such works?

7. Having regard to economy of construction and maintenance, expedition of construction and efficiency of operation—

(a) Which of the works should be constructed under the technical supervision of an International Board and what other works, if any, might advantageously be constructed under such supervision?

(b) Which of the works should be maintained and operated by an International Board and what other works, if any, might advantageously be so maintained and operated?

8. What, if any, readjustments in the location of the international boundary are necessary or desirable to place power structures belonging to either country within its borders, as recommended by the International Joint Commission?

9. If the Board is of the opinion that it would be advantageous to provide in the first instance for channel depths other than 25 ft., but less than 30 ft., for what draft of vessel should provision be made?

10. Having regard to the recommendation of the International Joint Commission that the new Welland Ship Canal should be embodied in the scheme and should be treated as a part thereof, and to the fact that if a greater depth than 21 ft. be adopted for the initial project depth of the St. Lawrence, such greater depth would not be available to the upper lake ports without further work in the navigation channels in the Lakes, what would be the cost of improving the main navigation channels between

and through the Lakes, so as to provide, without impairing the present lake levels (a) for a depth of 25 ft. and (b) for such other depth, not exceeding 30 ft., as may be determined by the Board to be that for which it would be most advantageous to provide on the St. Lawrence River?

11. What is the time required to complete the proposed works, the order in which they should be proceeded with, and the progress which should be made yearly toward the completion of each in order to secure the greatest advantage from each of the works and from the development of the waterway as a whole?

It is desired that the report be accompanied by such drawings as are necessary for showing the location and general character of the works proposed.

It is also desired that in the preparation of the report, due regard should be had to any diversions from or in the St. Lawrence River watershed, which, at the date of the report, are authorized by license by either Canada or the United States.

It is desired that the Board report, from time to time, on the matters referred to it as the progress of its inquiries permits, and that these inquiries be so prosecuted that, if practicable, the Board should have reported on all such matters by the end of April, 1926.

History of Negotiations—After correspondence which had lasted several years, last May the two governments got together in the appointment by each of a commission for joint action by the United States and Canada for the improvement of the St. Lawrence River between Montreal and Lake Ontario for navigation and the development of water power. In connection with these commissions each government appointed an engineering board. These two boards met in Montreal, June 20, 1924, and formulated the recommendations for instructions for the investigation.

On July 2, Secretary Hughes wrote to the diplomatic officer of Great Britain who is representing Canada in the negotiations that by Section 6 (a) of the recommendations, the Board of Engineers would be charged with reporting on the effect of the diversion of 5,000 cu.ft. and 10,000 cu.ft. of water per second from Lake Michigan, on the quantity of water available for power in the St. Lawrence as well as on the water levels of the Lakes and the St. Lawrence River, but by Section 6 (b) it would be directed to investigate the effect of the discharge of water from Lake Erie only in so far as it would be affected by an increase in the discharge of 1,000 cu.ft. of water per second. In view of this, the United States government suggested a new clause 6 (b) to read as follows: "To what extent and in what manner would the natural water levels in the lakes and interconnecting channels be affected by an increase in discharge of 1,000 cu.ft. per second of water from Lake Erie and to what extent will the unequal diversions of water from Lake Erie and the Niagara River for power balance power lost, due to diversions from Lake Michigan?" In all other respects the United States government agreed to the recommendations.

Under date of Aug. 18, the British government refused to accept the amendment, saying "The government of Canada considers the introduction by the proposed amendment of the question of the division of water at Niagara as an extension of the reference originally intended, and they regret therefore that they are unable to accept it."

On Sept. 10, Secretary Hughes agreed to accept all of the instructions, leaving out Section 6 entirely. This the British government refused under date of Oct. 20, but said that the Canadian government would have no objection to the reference back to the technical officers of all the questions embraced in Section 6. The two countries thereupon agreed to a reconsideration of Section 6. The technical officers met on Dec. 2 to 4, 1924, and submitted the recommendations in Section 6 as finally agreed upon and as printed above, together with the added two final paragraphs as they appear in the accepted agreement. This the United States agreed to in a letter of Dec. 29, "on the understanding reserved by its technical officers that consideration at a future time of the unequal diversions of water of Niagara as bearing on the diversion from Lake Michigan is in no wise prejudiced by the omission of the question from those which it is at this time proposed to refer to the Joint Board of Engineers."

The British government, in a letter dated Feb. 4, states that the Canadian government also approves the final report subject to the following understanding: "That the words 'by either Canada or the United States' as appearing in Section 6 (a), mean the federal authority in each case, and, furthermore, that the consideration by the engineers of the effect of the diversion of water at Chicago on the St. Lawrence project is not to be taken as admitting that any license to take water from the St. Lawrence basin which may be granted by the government of the United States is binding upon Canada, whatever may be its validity under the domestic law of the United States."

On March 17, Secretary of State Kellogg, writing for the United States, said: "While the government of the United States is not advised of the reason of the Canadian government for desiring to restrict the scope of the investigation to be made under Section 6 (a) to diversions authorized by the federal authorities of the United States or of Canada, and believes that the investigation would be more satisfactory if it were not thus restricted, it will nevertheless, with a view to avoiding delay in the consideration of the major questions involved, and without prejudice to any of its legal rights in the premises, not interpose any objection to the first of the understandings stated by the Dominion government. Likewise, this government will make no objection to the second of those understandings. In addition to the observation above that the acquiescence of this government in the first of the foregoing understandings is without prejudice to its legal rights, this government considers that it is appropriate to remark that as the work of the Joint Board of Engineers will be limited to the investigation and determination of facts and the preparation of plans and estimates, the legal rights of the United States and of Canada in relation to any question will not be affected by reference or omission of reference of it or of other questions to the board or by the action of the board on the questions that are referred to it."

Following this, each government gave instructions to its members of the Joint Board of Engineers in accordance with the joint report as printed here.

Power Resources of Blue River in Colorado

The engineers of the U. S. Geological Survey in their recent studies of the Blue River Valley in Colorado have found that there are six power sites between Breckenridge and the mouth of the river which have a capacity, with the existing flow, of 22,000 and 12,000 hp. for 50 and 90 per cent of the time. With regulation through the construction of a reservoir in Green Mountain Canyon this power output can be increased to 45,000 and 42,500 hp. for 50 and 90 per cent of the time.

Safeguarding Long Highway Bridge From Fire and Other Damage

Fire Stops Placed in Approaches Minimize Danger From Chimney Effect—Other Features—Means of Toll Collection

AN INTERESTING feature of the bridge crossing the Columbia River at Hood River, Ore., to White Salmon, Wash., a toll bridge privately financed and recently completed (see *Engineering News-Record*, Jan. 5, 1925, p. 130), is the precaution taken against damage by fire.

The profile of the bridge indicates the long grades on the wooden approaches and for the deck spans, the only length of the entire structure (4,300 ft.) having a level grade being the channel span of 262.5 ft. Thus, the conditions for chimney effect between the wooden stringers, under normal circumstances, are very pronounced. The plans called for overcoming this danger in the following detailed manner:

(1) Fire stops consisting of two sets of solid bridging spaced 3 ft. apart and placed on the approaches over every tenth bent (i.e. every 187.5 ft.) serve to prevent the spread of fire by chimney effect. On the deck spans, the solid bridging is placed over each pier (208 ft.). By means of the double fire stop the possibility of fire jumping under one stop is eliminated.

(2) The deck is 20 ft. wide and supported by 5x16-in. stringers, the floor system being designed to pass two 20-ton trucks. The deck is composed of 4x10-in. timbers 20 ft. long set flatwise and running clear across at right angles with the bridge with manholes set in over every fire stop.

The total cost of the bridge is about $500,000, yet it is in every way a substantial structure, designed to carry the heaviest loads, and meet fully the traffic conditions as they are likely to exist. This is a very small investment for a bridge crossing a river 3,200 ft. wide at low water, which must not interfere with navigation, yet has no movable features, and must be prepared to pass under it a flood of 1,200,000 sec.-ft. with an increase in river stage from low water of 53 ft.

For such high lightly-loaded piers they must be proportioned carefully to resist overturning and prevent excessive loading of the bearing piles. These conditions have been met in a novel manner by spreading the "dumbbell" type of piers at the bottom, not by increasing the batter on the cylinders whose axes are usually vertical, but by placing the axis of the cylinders or shafts on a batter themselves, thus obtaining the same effect with greatly reduced increase in cost. In a similar way the maximum loading on the bearing piles is kept at a maximum of 28 tons under extreme conditions by grouping the piles as thickly as possible near the ends of the footings where the lever arm to the resisting moment to overturning is greatest.

The bridge was financed by the efforts of two engineers, Elbert M. Chandler and Henry L. Gray, who had crossed the river on the old ferry and recognized the desirability of a bridge at this point. It was financed by having a first mortgage bond issue underwritten by a banking house for 60 per cent of the estimated cost of the bridge and the balance of the funds raised by the sale of preferred stock, cumulative and participating, this stock being purchased through the Chamber of Commerce of Hood River by local and Portland people interested indirectly in the bridge. A small issue of common stock covered franchises and financing expenses.

In addition to fire protection as above noted, the investors are protected by a special insurance policy covering loss by tornado, earthquake, flood, ice, malicious damage or public liability. Within two weeks after the bridge was opened, the worst cold spell known to this region occurred, freezing the Columbia River clear over, a foot thick. When the ice broke up, no damage of any kind was done, certainly a most severe test so far as ice was concerned. Upon the opening day, 5,000 cars crossed the bridge and the channel span was loaded with people during the dedication, as thickly as they could stand or hang on and the rest of the bridge loaded with two lines of waiting automobiles.

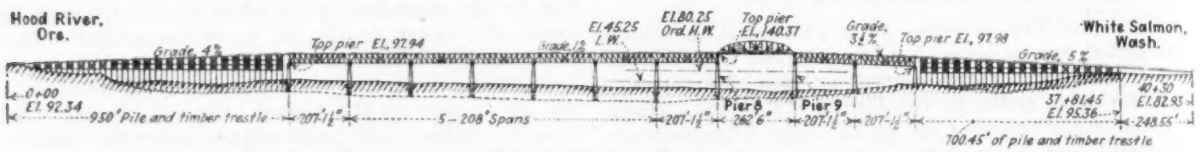


FIG. 1—ELEVATION OF TOLL BRIDGE ACROSS COLUMBIA RIVER SHOWS LONG GRADES

One collector handles the collection of tolls at a time, being stationed in a small booth in the center of the road on the Oregon end of the bridge, so that cars pass on either side and the toll is paid without delay or anyone being inconvenienced. A complete record of the

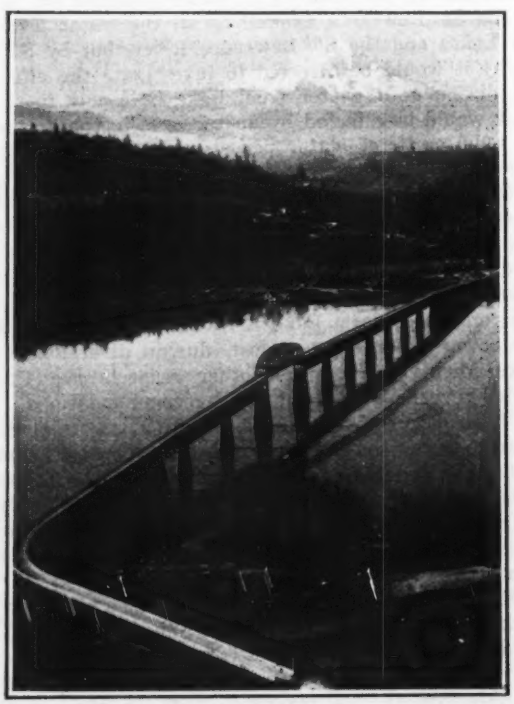


FIG. 2—TOLL BRIDGE SPANNING COLUMBIA RIVER

traffic is kept by means of a special cash register, a sample strip from the machine being here shown. The first column at the left indicates the capacity of the truck or the number of horses, if a vehicle, as 1T, meaning a one-ton truck and 2H meaning a two-horse wagon. The second column records the license numbers of autos and trucks and thus enables checking up on the collector to be done at any time by a recorder of license numbers at the other end of the bridge.

The third column records the type of customer as "Pe" meaning pedestrian, "Tr," meaning truck, "Ve" meaning vehicle or wagon, "Ls" meaning livestock, and "Au," meaning auto. The next column indicates who the collector is by letter, *A* being the day collector, *B* the night collector. The next column indicates the number of persons involved in each transaction. If pedestrians and the strip shows +2, it means two persons, if an auto with +2, it means two passengers besides the driver. The next column indicates the cash toll received and the last column indicates the number of the transaction. These strips are taken off the machine daily at 2 p.m., taken to the bank and deposited with the exact amount of cash received during the preceding 24 hours, the bank forwarding by mail to the treasurer the cash register slip and a duplicate deposit slip for the amount. In this way, there is a complete record with a minimum of labor and red tape.

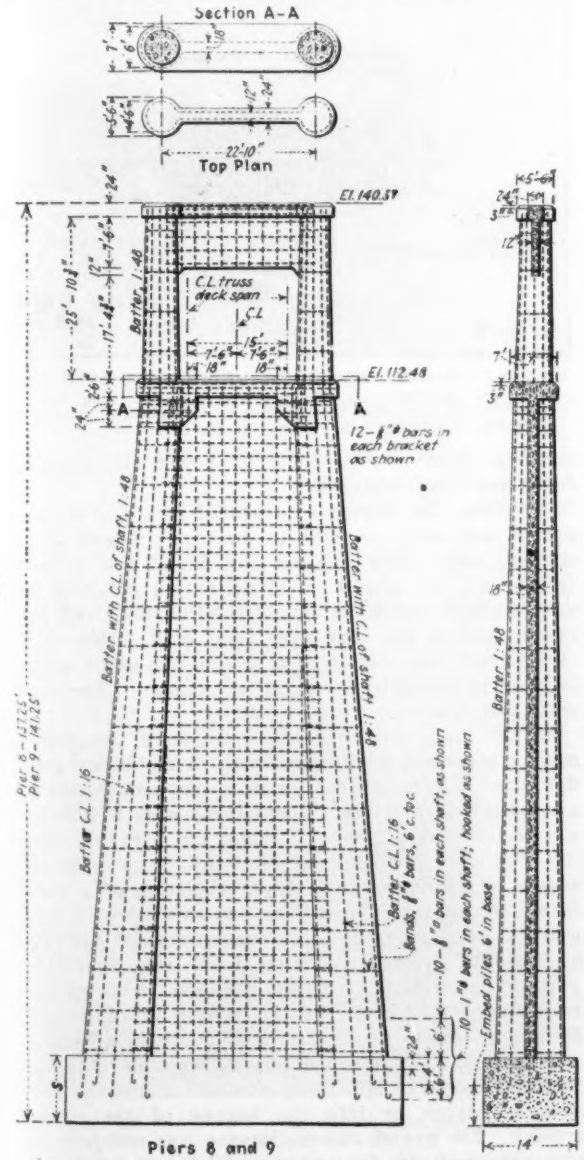


FIG. 3—DETAILS OF CHANNEL SPAN PIERS

	PeA*+2−.20	-4945
1T358154	TrA*+1−.85	-4946
2H	VeA*+0−.75	-4947
	LSA*+1−.10	-4948
358154	TrA*+1−.85	-4949
	MsA*+0−.20	-4950
1T	TrA*+1−.85	-4951
3870	AuA*+31.05	-4952
176688	AuA*+2−.95	-4953
57935	AuA*+1−.85	-4954
54105	AuA*+0−.75	-4955
	PeA*+1−.10	-4956
1T	TrA*+0−.85	-4957
163057	AuA*+1−.85	-4958
176688	AuA*+1−.85	-4959
	PeA*+2−.20	-4960
	PeA*+1−.10	-4961
1T	TrA*+0−.75	-4962
1T 94035	TrA*+0−.75	-4963
	PeA*+1−.10	-4964
535	AuA*+1−.85	-4965

FIG. 4—SAMPLE STRIP OF TRAFFIC RECORD

The bridge was built and is owned and operated by the Oregon-Washington Bridge Co., Elbert M. Chandler, president. The engineers for the company were Gray & Chandler, of Seattle. The contractor who built the bridge is the Gilpin Construction Co. of Portland. C. N. McDonald veteran bridge builder of the Northwest, superintendent, who awarded the steel fabrication for the ten spans to American Bridge Co. The bridge was designed by Elbert M. Chandler, the steel detailed by C. H. Eldridge of Seattle, and the resident engineer for Gray & Chandler was Maj. C. M. Hurlburt. The plans were reviewed and approved prior to construction by Col. C. B. Wing, for the underwriters, Col. Wing being head of the department of civil engineering at Stanford University.

Change in Automobile Fatality Statistics

Complaints having been made that the automobile fatality statistics published by the Bureau of the Census are unfair to some cities in that they include deaths within hospitals from accidents outside the cities in which the hospitals are located and against which the deaths are charged, a plan has been devised by the Census Bureau for reporting hereafter not merely the number of deaths from automobile accidents within a city, but also where the accident took place.

Building Wilson Dam at Muscle Shoals on the Tennessee—II

How Work Was Planned, Construction Camp Located, Excavation and Sub-Foundation Carried Out and Concrete Placed on the Largest Dam in the Country

This is the second of two articles on the building of the Wilson Dam at Muscle Shoals. The work is described in four sections, of which Section 1, Construction Plan and Work Quantities, and Section 2, Foundation Exploration and Excavation, appeared in "Engineering News-Record" April 23, p. 676, and the other two, Section 3, Concreting Plant and Procedure, and Section 4, Electrical Equipment of Construction Plant, comprise this second article.—EDITOR.

3. Concreting Plant and Procedure

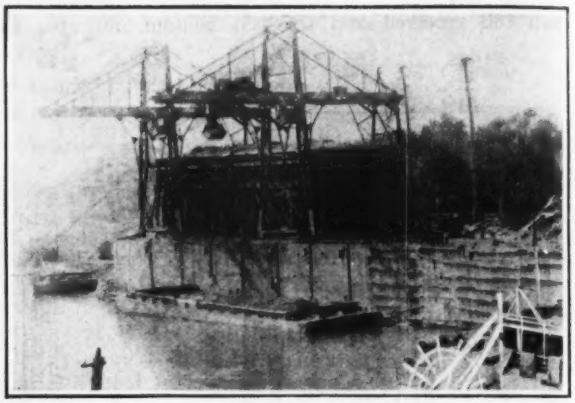
Rigid Requirements for Concrete Quality Met By One of The Largest Mixing and Placing Plants Ever Installed

CONCRETE construction was the controlling operation of building Wilson Dam. Excluding 78,500 cu.yd. in the locks and 87,500 cu.yd. in miscellaneous structures, there were 1,234,000 cu.yd. of concrete in the dam structure proper. In its outstanding features, then, the construction plant was a plant for mixing and placing concrete in large volumes. Besides volume of concrete, there stood out two other features: (1) Complexity of concrete structure particularly in the power house section and (2) quality of concrete construction. Volume, complexity and quality were the determining influences affecting plant planning and construction methods. Cost and progress were affected more by other influences—force-account construction and interrupted operations. This differentiation has to be kept clear in reviewing the several elements, which will now be taken up, of the construction operation.

Concrete Quality—Perfection of concrete was sought by the engineers. Two mixtures of concrete were required; one called for five bags and the other for six bags of cement per cubic yard. An addition of 25 lb. of hydrated lime per cubic yard was required or, in the lack of this, an additional half-bag of cement. A fixed volume of 25 cu.ft. per cubic yard of coarse aggregate was specified and enough sand to make, with the cement, 15 per cent more mortar than would fill the voids in the coarse aggregate. Only screened aggregate was permitted, conforming to the usual requirements for cleanliness. A mixing time was set of 2 min. for 2-cu.yd. mixers and of 2½ min. for 4-cu.yd. mixers. Consistency was required to be such that "men dumping concrete buckets do not track deeper than 10 in. nor less than 2 in. in green concrete."

Equal precision was required in methods of placing. Besides the usual rule requiring placing before initial set, it was stipulated that no concrete should be put on placed concrete in which initial set had occurred, until the placed concrete had set hard enough not to distort under the load. Except in the aprons and a few other parts, bucket placing was required in layers of 4 to 6 ft., and in no case was the free fall from the bucket to exceed 4 ft. At temperatures above 90 deg., tarpaulin covers and wetting for 45 hours were required. Particular care was taken in forking and spading.

In general the six-bag mixture was used for all of the power house above footings, for the dam above the rollway crest, for the bells and for all reinforced concrete. All other parts of the structure, including the great rollway mass of the spillway section, were of the five-bag mixture. In practice, both mixtures, with the hydrated lime to increase work ability, the quaking consistency and the careful spading, produced a remarkable surface as shown by several of the illustrations. Cuts into the concrete showed also a notably dense and tough material.



GANTRY CRANES UNLOAD GRAVEL BARGES INTO BINS
Concrete aggregate is dredged and screened nine miles downstream, unloaded from barges by this plant and transshipped by trains to the dam.

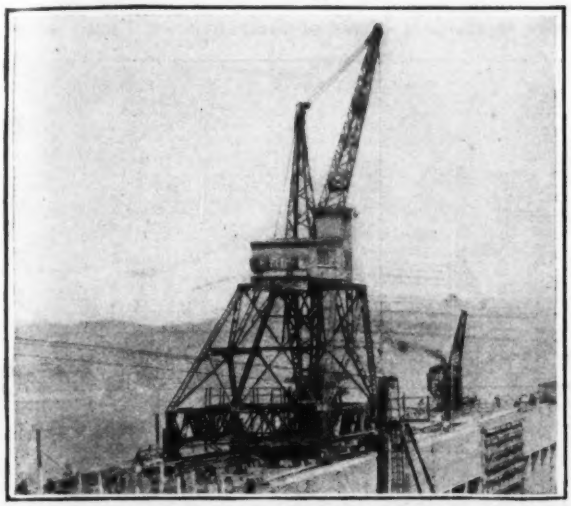
Crushing and Mixing—Excavated rock and screened gravel and sand, brought to Jackson's Island as described, were there reduced and mixed into concrete by one of the largest construction-job crushing and mixing plants which, outside of the Panama Canal locks plants, had at the time ever been built. One of the views gives some notion of a part of the plant, and its location is shown by the plant layout plan. The equipment and operation were as follows:

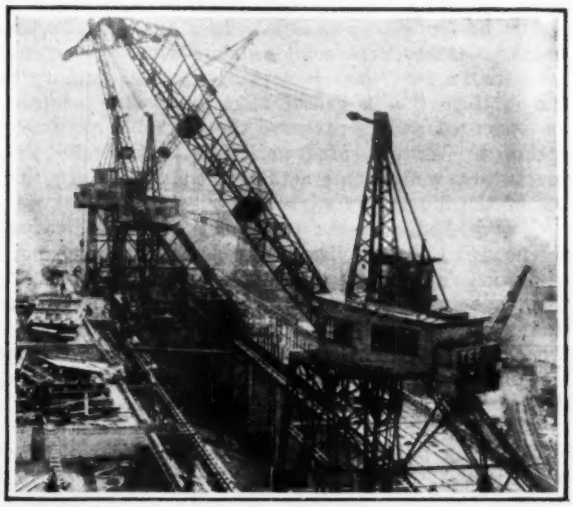
In the main mixing plant there were two 4-cu.yd. mixers arranged to discharge into 4-cu.yd. buckets on flat cars. Above the mixers were measuring bins and a hopper floor and again above these were a 400-cu.yd. gravel bin and a 200-cu.yd. sand bin. Finally above the bins were revolving screens. All these units were housed in a building 85 ft. high consisting of a wooden frame on concrete foundations and covered with corrugated iron. The co-ordinate crushing plant comprised a 48x60-in. crusher reducing to 6 in.; four 14-in. gyratory secondary crushers, and two 14-in. gyratory re-crushers. Adjacent to the mixer building was a 400x40-ft. cement house storing 25,000 bbl. in bags.

The stone and gravel delivery railway, elevated about 20 ft., delivered by side-dump cars either into the gravel storage hopper or into the hopper of the primary crusher. The gravel storage hopper was concrete lined and delivered, 18 ft. underground, to the foot of a

60-in. pan conveyor 100 ft. long rising to the screens over the bins. This pan conveyor could also deliver to the re-crushers. Rejects from the screens went to the re-crushers. This was the gravel movement. Carloads of stone, washed on the cars, were dumped directly into the hopper of the primary crusher. From it the stone was taken by a 49-ft. pan conveyor to a shaking grizzly and thence to the hoppers of the 14-in. secondary crushers and thence to the pan conveyor rising to the screens. The rejects from the screens went to the re-crushers.

Sand delivery by train was stockpiled on the opposite side of the plant from the stone and gravel. A 100-ft.-boom guy derrick here loaded with a 1½-cu.yd. clamshell from stockpile to sand bin. The cement came in bags. A 400-ft. belt conveyor along the cement house fed onto an inclined belt discharging into a bulk cement bin above the mixer floor. This bin gated into the measuring hopper of a shuttle car which ran to a point over the mixer hopper. From the storage bins sand and gravel were gated into a measuring bin over the mixer hopper. There was as little hand work as possible in proportioning and mixing. There were eight men in the mixer crew and 22 men in mixer and crusher crews combined. The mixer plant worked two 8-hr. and one 6-hr. shifts daily.





FULL-CIRCLE TRAVELING CRANES PLACE CONCRETE; CRANE WITH GOOSE-NECK BOOM AT RIGHT

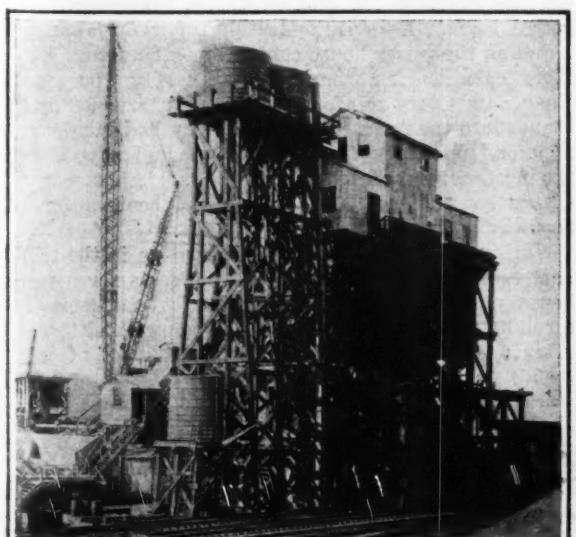
Ten cranes were used taking 4 cu.yd. buckets from cars. They also handled excavated rock in skips and set forms.

The gooseneck attachment for the regular crane boom was used when longer reach became necessary for high work.

Each of the subsidiary mixing plants located as described previously had two 2-cu.yd. mixers. The two on the shores had independent cement houses and all subsidiary equipment required of a self-contained unit. That in the power house cofferdam was served in part from the other plants. The power equipment of all plants is considered under a later heading.

Concrete Distribution—Distribution was in full batches by job railway to traveling cranes which delivered to the forms. The track system was described in the first article (April 23, p. 676). A 25-ton locomotive hauled two 40-ft. flat cars each carrying two 4-cu.yd. buckets. When advantageous for narrow or small parts of the work, 2-cu.yd. buckets were substituted. Chiefly the problem in train schedule and loading was to synchronize them with crane capacity and pouring speed to insure placing within the specified period after mixing. Neither train units nor buckets call for special notice. The handling cranes were, however, rather special equipment.

There were ten full circle traveling cranes, seven of one make for the spillway portion of the dam and three of another make for the power house work. A group of the main dam cranes is shown; they had 65-ft. masts, 83-ft. booms and a capacity of 10 tons at 75-ft. radius. The three power house cranes had 100-ft. masts, 115-ft. booms and a capacity of 10 tons at a radius of 108 ft. One of the cranes is shown with a hammerhead extension to the boom for certain long-reach operations. The electric power equipment of these cranes is described in the section on electric equipment. All were capable of handling and holding the full-batch bucket of 4 cu.yd.



STONE CRUSHING AND CONCRETE MIXING PLANT ON JACKSON'S ISLAND

Seven stone crushers and two 4-cu.yd. mixers with conveyors, screens and all appurtenances make up one of the largest unit mixing plants ever installed.

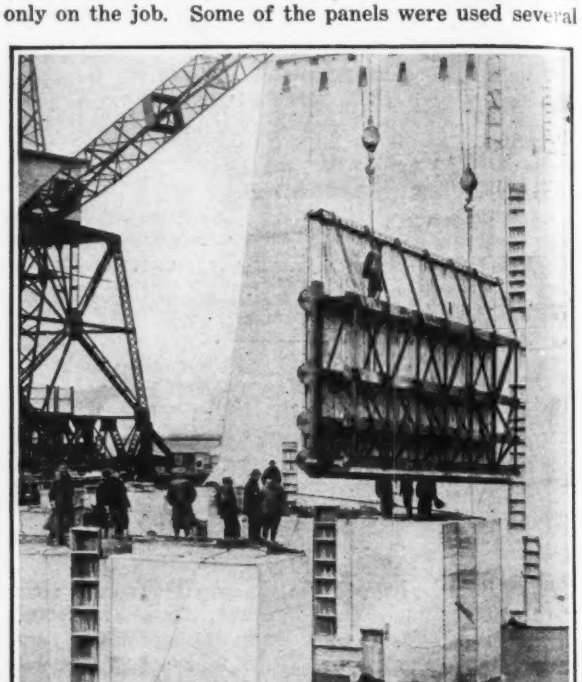
The dam was concreted in blocks 38 ft., 48 ft. and 54 ft. long separated by expansion joints consisting above 80 deg. F. of one thickness of tar paper, between 40 and 80 deg. F. of two thicknesses, and below 40 deg. F. of three thicknesses. The lifts in each block were 4 ft. to 6 ft. In every joint keyways 24x10 in. had to be formed as specified. In placing concrete the usual processes were employed but with very particular care to do thorough forking and spading, to get the mixture finally placed before any sign of initial set appeared and to preserve the workable consistency specified. With careful work the concrete by these precautions was given a notably good surface as a number of the illustrations indicate.

Closing Spillway—As previously explained, to pass the floods 29 of the rollway sections between piers north of Jackson's Island were left open. The closure of these openings required special methods. In this part of the dam, while the cofferdams were in, the footing trench concrete was completed and the piers were carried up to the springing lines of the roadway arches. As these piers were tall and slender, damage from the impinging high water current was feared and each was stiffened by building 4 ft. of the rollway section on one side. These projections were placed on facing sides so that the openings between piers were alternately 30 ft. and 38 ft. The closure required filling these openings with rollway structure. The procedure was as follows:

The bottom of the openings were about 7 ft. above the natural bed of the river and about 23 ft. above the lowest foundations of the dam. In filling them the principal difficulty was in excluding the water. This was accomplished by closing approximately one-third of the total number of openings with temporary gates while the flow of the river was allowed to pass through the remaining two-thirds of the openings. There were 13 permanent circular sluices, each 9 ft. in diameter, in the channel south of Jackson's Island but the capacity of these was not sufficient to take care of the entire discharge of the river during most of the period in which the work was going on. As soon as one-third of the openings had been unwatered a horizontal layer of concrete 6½ ft. thick was deposited in each and when this had sufficiently cured the gates were removed and placed in other openings. In this way openings were alternately closed and opened all the way across the dam and the elevation of the bottom of the openings raised 6½ ft. Then the same process was repeated. This process naturally raised the pool above the dam, thereby increasing the pressure on the permanent circular sluices. Because of this and the natural decrease in the flow of the river during the summer months the circular sluices carried all the flow of the river when the pool reached an elevation of about 460 ft. The remaining concrete to the top of the spillway was deposited in the dry without the need of gates.

Two types of temporary gates were employed. For the wider openings 12x16-in. stop logs with 8-in. I-beams in the joints were used. The narrower opening required a movable gate as illustrated, the particular features of which were the rollers and the method of making the joint tight by use of an inflated hose.

Form Fabrication and Cost—Variety in forms ranged from plain panels for the back of the dam to the complex shapes and joinery demanded in molding cones, bells, scroll cases, etc., for the turbine emplacements. Some of the views indicate structure and complexity. There was, as shown by the plant map, a form carpenter shop on each shore. These had band and circular saws, all tools and layout platforms. So far as practicable form units were built at the shops and erected and fitted only on the job. Some of the panels were used several times but a great many of the form units were discarded after serving once. Effort was made to use sizeable units as the cranes enabled easy handling of heavy loads. As an illustration of this large unit handling the power house columns may be used. A one-story column form complete was set by the cranes. Then a two-story reinforcing cage was threaded by the cranes into the form. When this story had been poured a second one-story form was lifted and slipped over the upstanding reinforcement. In a similar way the cranes set wall and pier panels and centers for the roadway bridge arches.



GATE COFFERDAM CLOSED SPILLWAY OPENINGS
Rollway sections omitted between piers to pass floods were built behind gates which dammed openings as view indicates.

Various figures on form costs are given in the tables. Interesting special examples are the costs for a power house unit including penstock, draft tube, cone and scroll case. These were built to drawings, and torn out after use with virtually no salvage. A set of forms cost on the average about as follows:

Form	Building	Erecting
Penstock	$11,650	$2,750
Draft tube	7,817	6,782
Cone	1,170	245
Scroll case	7,724	1,822

These were field costs alone. The yardage of concrete in a power house unit was 9,301 cu.yd. mass concrete and 8,056 cu.yd. reinforced. On this basis the cost of forms per cubic yard was:

Item	Mass	Reinforced
Building	$0.34	$2.62
Erecting	0.88	2.92
Removing	0.23	0.58

TABLE II—FIELD COSTS OF CONCRETE—PER CUBIC YARD

	Dam Section			Power House Section			
Sub-Division	Lock Section	Dam and Piers	Bridge (Arches)	Mass	Mass-reinforced	Reinforced	Superstructure
Cement	$3.39	$3.22	$3.69		$4.01	$3.67	$3.60
Sand	0.53	0.60	0.53	$5.43	0.53	0.52	0.44
Gravel	1.04	1.08	1.25		1.03	1.24	1.06
Crushed rock	0.07	0.13	0.02		0.12	0.00	0.00
Plumstone	0.01	0.01	0.00	0.01	0.00	0.00	0.00
Mixing	1.01	0.83	1.21	0.71	1.01	2.14	1.56
Hauling	0.75	0.37	0.66	0.41	0.58	1.37	1.43
Placing	1.04	0.70	1.28	0.77	.21	3.34	6.46
Form building	0.55	0.65	2.98	0.51	2.48	7.31	11.30
Form erection	2.09	1.21	5.96	1.05	2.78	8.04	9.83
Form removal	0.31	0.22	0.96	0.24	0.49	1.73	0.99
Total	$10.79	$9.02	$18.54	$9.13	$14.24	$29.36	$36.67

The 17,357 cu.yd. of concrete in the same unit cost $11.40 a cu.yd.; $8.70 a cubic yard for mass and $14.40 a cubic yard for reinforced. These figures are all field costs.

Concrete Costs—Considering only the concrete in main structures, including the locks, the cost of concrete to Sept. 17, 1924, had been as shown by Table II. These costs are strictly field costs and do not include main line railway, shop and warehouse, camp, engineering, superintendence, clerical and other costs which for concrete work were about 46.8 per cent as much as the direct field costs. It will be observed that some very high-priced concrete has gone into portions of the work.

4. Electrical Equipment of Construction Plant

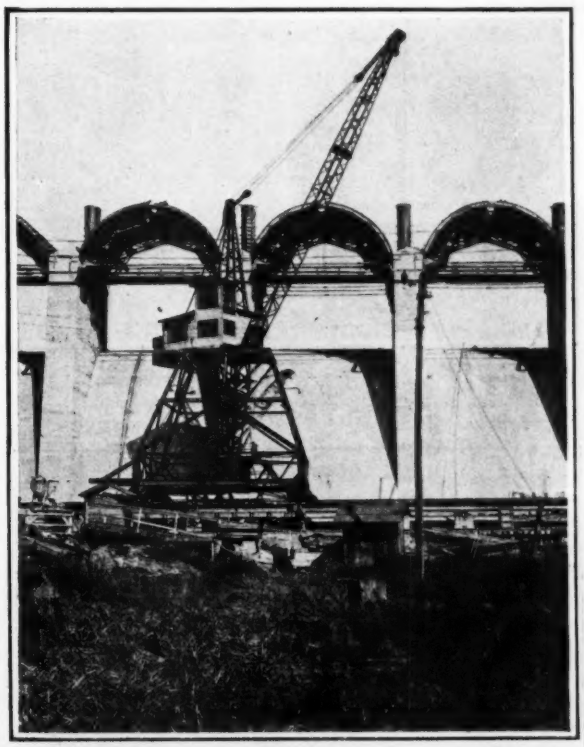
Probably The Largest Motor Installation Purely for Construction Equipment In Operation in America

Virtually all the equipment of the Wilson Dam construction plant, except essentially steam units like tow-boats, railways and steam shovels, was electrically operated. The plant motors aggregated over 7,000 hp. In addition, current was used for lighting camp and work, for cooking and heating and for various other services. The consumption of current is difficult to arrive at, since there were individual generating sets on floating plant and at the Lock 6 and Buck Island operations, but in the maximum month of October, 1923, the current supplied by the Alabama Power Co. was 1,182,092 kw.-hr., with a maximum demand of 2,810 kw. This current came in at 13,200 volts and was reduced by job transformers to the voltages required by the various motors and services.

Distribution—There were two dam substations, one located on Jackson's Island and the other on the south shore of the river. At the Jackson's Island station there were three 60-cycle, 1,667-kva. oil-cooled transformers and at the south side station there were three 2,050-kva. oil- and water-cooled transformers. These distributed, through a three-phase system, current for motors ranging from 400 hp. to ½ hp., and for the 2,000-volt system for job and camp lighting. Power consumption has already been indicated. Local distribution was provided either by temporary aerial lines, or, as was more general on the construction operations, by three-phase 2,200-volt armored cable. In some places where abrasion was particularly a hazard this cable was run through wood, tile or iron protecting conduits. Ordinarily the cable with no protection ran through mud and water or on the ground wherever it was convenient to lay it.

Generally speaking each substation served a different section of the operations. That in Jackson's Island first, naturally, served the large Jackson's Island plant of mixers, crushers, etc., described elsewhere. Secondly it provided current for the lock construction operations and all the north shore shops, camp, office and service buildings. Third, it served the Florence docks, approximately 3½ miles downstream where sand and gravel were unloaded from river craft by gantry cranes and sent to the dam by railway. In general all current used on the island operations and by the construction plant and general services north of the island came from the Jackson's Island substation.

Virtually all services and construction plant south of Jackson's Island got current from the south side substation. These operations embraced all the power house construction, the exploration tunnel work in the south abutment cliff, and the south shore camp buildings and shops. Here, as on the north side, construction services included the operation of cranes,



ERECTING ROADWAY BRIDGE ARCH CENTERS
Roadway bridge across dam has over a hundred 38-ft. arch spans. Centers had steel ribs and ties and wood lagging.

pumps and mixing plants and the operation of flood lights, and individual weatherproof units of from 25 to 1,000 watts capacity. In the south bluff tunnel work alone, at the height of activity, about 1,400 lights were employed 24 hours a day.

All this purchased power was alternating current. In addition direct current was supplied by steam-electric plants for the operations at Lock 6 about three miles up the river and at Buck Island about twelve miles downstream. It was from Buck Island that virtually all the sand and gravel came for concrete aggregate. Also there were individual lighting plants on floating equipment—tow boats, dredges and launches.

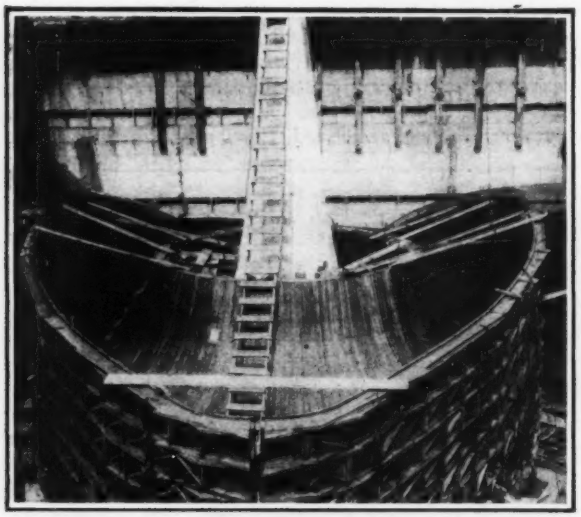
Motor Equipment—The motors, as previously stated, ranged in size from ½ hp. to 400 hp. Half a score of makes were represented. This variation in make arose from the fact that many of the motors were transferred from other government construction operations. Many, too, were designed for other than 60-cycle current.

These were not desired conditions but yet very good success was obtained with 50-cycle motors designed for other work, by modifying the control apparatus to adapt it to a 60-cycle system.

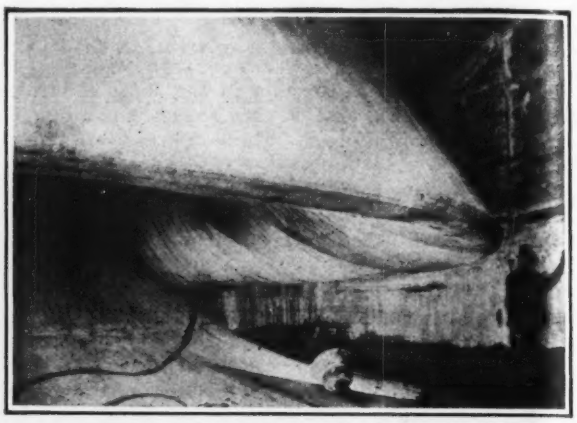
The largest motors, 400 hp., were seven which operated the seven air compressors described in the preceding section on foundation construction. These large motors were of the synchronous type and in addition to driving the air compressors had a reserve capacity for power factor correction on the system. The second motor group in importance was that for the concrete plant on Jackson's Island. A 300-hp. motor operated the large crusher; the six secondary crushers, two mixers and the main conveyors were operated by nine 100-hp. motors. Smaller conveyors, screens and minor machines were operated by one 75-hp., two 25-hp., one 50-hp., one 7½-hp. and six 3-hp. motors. The aggregate was 1,400 hp., while the compressor motors aggregated 2,800 hp.

The third group was crane motors. There were on the dam seven Terry and three McMyler cranes and at the Florence docks two gantry cranes for unloading barges. Each of the Terry cranes had a 75-hp. hoist motor, a 52-hp. boom motor and a 25-hp. motor for bridge drive and swing operations. On the McMyler machines a 100-hp. motor operated the hoist and boom, and there was a 75-hp. motor for bridge travel and a 25-hp. motor for swinging. The ten derricks had then an aggregate of 1,664 motor horsepower. On each of the two gantry cranes there were a 112-hp. hoist motor, a 112-hp. bucket closing motor and a 52-hp. motor for crane movement. The aggregate was 552 motor horsepower. The grand total motor equipment of compressors, concrete plant and cranes was then 6,416 hp. Incidentally the Florence dock cranes got current from an auxiliary substation of three 125 kva., 13,200-400-volt transformers.

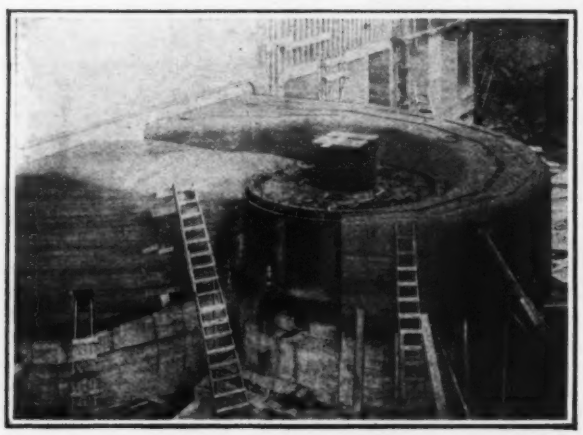
Besides the main concrete plant on Jackson's Island, there were three smaller mixing plants, one on each shore and one in the power house cofferdam. There was some change of position of these plants as work progressed but the motor equipment was constant. The



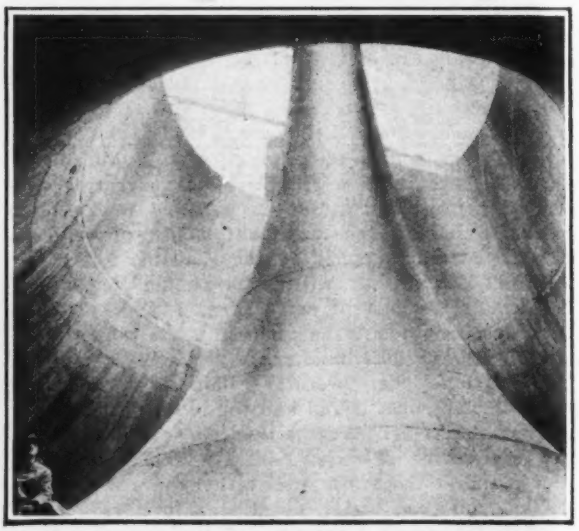
ERECTING BELL FORM AROUND CONE
These forms are elaborate and complex examples of accurate carpentry. They are built from drawings prepared with all the care and detail of those for intricate steel work.



BOTTOMS OF DRAFT TUBE, CONE AND BELL
Man standing furnishes scale. Both cone and bell are unreinforced, making a remarkably bold design in concrete.



FORM FOR SCROLL CASE PARTLY COMPLETED
This form molds scroll case which receives water from triple penstock and distributes it around periphery of turbine runner.



CONE AND BELL LOOKING ALOFT FROM DRAFT TUBE FLOOR
The man again gives a scale. Concrete shown as it came from the forms.

south side plant had one 40-hp. mixer motor, a 15-hp. conveyor motor and three 3-hp. motors for bag shaker, sack baler and a stacker. The other plants each had two 40-hp. mixer motors and one 30-hp. and two 20-hp. motors for conveyors and bag shakers. The aggregate motor equipment for auxiliary mixing plants was 364 hp.

Miscellaneous uses of motors were as follows: The camp was protected by a centrifugal fire pump held in readiness for service at all times, and driven by a 75-hp. motor; capacity 100 gal. per minute, 125-lb. pressure. Near by was also an extensive refrigeration and cold storage plant for preservation of meats, vegetables, etc. This was operated by the plant where ice was made in quantities for the camp as a whole. Here a 10-hp. motor operated the brine agitator, a 5-hp. motor operated the circulating pump, and a 40-hp. motor drove the compressor. In cofferdam 1 there was a 12-in. centrifugal pump operated by an 80-hp. motor, and a 12-in. centrifugal pump operated by a 100-hp. motor. The washing plant at the Island, where all large rock used in concrete was scrubbed and washed clean, was operated by a 75-hp. and a 5-hp. motor. In the north side carpenter shop the line shaft was driven by a 50-hp. motor and there were four smaller motors on individual drives. The north side machine shop was driven by a 40-hp. motor on the line shaft and there were three individual drives using 10- and 3-hp. motors.

Electrical Plant Upkeep—All electrical equipment was in control of an electrical engineer who was responsible to the district engineer in charge of construction. Under him was a foreman for each construction division and under them were electricians, linemen, cable-splicers, armature winders and general workmen. The total force was about 130 men. In each division there was a machine shop with an overhead hoist, a lathe, drill press, winding outfit and general tools. In these shops all ordinary motor and transformer repairs were made, and armatures were rewound.

Cincinnati Meeting of the American Society of Civil Engineers

River Transportation and Stream Pollution Main Subjects of Discussion—Railway and Waterway Men in Animated Discussion

FOR GEOGRAPHICAL reasons perhaps, the Cincinnati meeting of the American Society of Civil Engineers last week had as leading subjects of discussion the canalization of the Ohio River and the great rock-fill dam on Dix River, close by in Kentucky. The former was discussed in the general session of the society, and became the focus of a warm debate between waterway and railway spokesmen, among them Gen. Harry Taylor, Chief of Engineers, U. S. Army, and Frank H. Alfred, president of the Pere Marquette Ry. The Dix River dam came before the Power Division, and in spite of its remarkable features of design and construction was left virtually undiscussed. The same was true of an elaborate paper describing the new Miami River power station of the Cincinnati electric system. Simultaneously two other technical divisions were in session, the Sanitary Division to discuss stream purification and the newly formed Waterways Division to organize.

Outside of the technical program the 250 members and guests in attendance found welcome opportunity for foregathering and exchanging experiences and views in the course of several enjoyable social events, sightseeing trips and a river excursion arranged by Cincinnati hospitality. A party also visited the Dix River dam just after the close of the meeting.

Little in the way of business affairs of the society came before the meeting. What was accomplished by the Board of Direction was briefly reported last week (p. 703).

The Local Section Conference spent an entire afternoon and evening in animated discussion of a skilfully arranged program of topics relating to section activities and development, such as co-operation with the membership work of the Board of Direction, arrangement of section meetings, finances, participation in local civic affairs and increase of membership. Most striking of the facts brought out here was the effectiveness of the work done by some of the sections in civic matters.

In general, a gratifying harmony and co-operative spirit marked the conference, but two or three unexpected happenings came just at the close of the final session. Speaking for the San Francisco and Sacramento sections, H. D. Dewell expressed the belief of these sections that Local Section Conferences should be discontinued because the wide difference in conditions affecting different sections makes the exchange of experiences valueless. In sharp opposition to this view, it was moved by C. D. Avery (Washington, D. C.) that the conference system be changed so that four sessions would be held each year instead of one, and that the conference determine its own organization and officers. This motion was tabled, against the negative votes of Washington, Philadelphia, New Orleans, Cleveland and Ann Arbor. Finally, Thaddeus Merriman (New York) in a stirring homily criticized the conference for having failed to touch on its main subject, improvement of the work of the society. On the part of the Board's committee on technical activities and publications he declared the society's papers to be not high enough in quality, and the members to be remiss in their duty of contributing the teachings of their own experience for the general professional benefit. The conference originated, he said, from a sentiment that something was wrong in the society's work, due to the members failing in their individual membership duty, but the conference has not yet improved that work. Dean M. S. Ketchum (Urbana, Ill.) developed a similar theme, outlining the essential requirements of the society as a professional group: common interest, a specialized body of knowledge as the basis of the profession, and steady advancement of that knowledge by the work of the organization.

President Ridgway on Civic Obligations—Under the title "The Modern City and the Engineer's Relation To It," Robert Ridgway, in his presidential address, gave a remarkable review of city growth and the material development of cities. Then, turning to the vastly increased involvement of the engineer's work in city service, he asked that engineers take up their part of the burden of bettering city government.

To illustrate the much greater mechanization than growth of the city in recent times he cited the fact that from 1812 to 1925 New York City increased 62 times in population, but 400 times in its operating cost. The remarkable drift toward the cities, which in little over a century led to a decrease in the ratio of rural population in the United States from 90 per cent of the total to 46 per cent, appears to be slowing up, due perhaps to the recent extension of modern improvements to the farms. "Large cities have come to stay," said Mr. Ridgway, but added, "It is a grave question whether their future rapid growth should be encouraged. It is not economically sound to have them become too large. The cost of transporting the people workward and homeward, of bringing food to them and of providing for them in other ways adds a great load to an already burdensome tax not only on themselves but on the other people of the nation."

Ohio River Improvement and Transportation—Col. C. W. Kutz, Division Engineer of Rivers and Harbors at Cincinnati, opened a symposium on the relation of the Ohio River and its tributaries to transportation in the United States. He gave full statistical data on the river, its canalization, freight movement, and transportation costs. Prof. H. B. Luther, of the University of Cincinnati, followed with an outline of the relation of transportation to continuity and efficiency of industrial production, with special reference to traffic congestion and blockade in critical periods and with brief notes on an industrial survey of the Cincinnati region now in progress. His general theme was the importance of the added transportation capacity afforded by water routes, and of the greater interlinking of supply and consumption which they produce. President Frank H. Alfred, of the Pere Marquette Ry., then presented at considerable length a critical study of railway and waterway comparisons, which tended to show the Ohio River improvement to be unjustified by results. Concluding the symposium, J. A. Pollak described a river freight terminal project that has been developed at Cincinnati, to make use of river transportation when the improvement is completed.

Col. Kutz, after giving traffic and cost data, asserted the following economic principle:

> The people of the United States are entitled to have the products of the farm, mine and factory move from origin to destination by the cheapest means, all elements of cost considered. Every inland waterway project should be gaged on that basis. Projects that are economically sound should be prosecuted vigorously and their use encouraged by wise regulation of rates and by the establishment of joint rail and water rates so as to make them an integral part of the country's transportation system.

Mr. Alfred claimed that water rates adjust themselves to a little below rail rates, instead of the inverse adjustment. His analysis of river transportation cost gave a total of 2.24c. per equivalent mile, or about twice the ton-mile revenue of the Pere Marquette. Briefly summarizing, he likened the Ohio River to a very crooked railroad, with only half of rail traffic density, carrying heavily unbalanced traffic, at a cost twice as high per unit. The construction of the Ohio works, he declared, is an economic waste; it was a great experiment, which has proved a failure.

Of the animated pro- and anti-waterway discussion which followed the reading of the four papers only a few typical items can be noted here. J. E. Teal, speaking for R. N. Begien, of the Chesapeake & Ohio, gave specific traffic-cost comparisons which, like those of Mr. Alfred, showed Ohio River economies far from adequate to cover fixed charges except on a traffic many times that existing or in sight. He argued that railroads can handle all the traffic at all times, and that they can do it cheaper than joint water-and-rail routes.

Gen. Harry Taylor, Chief of Engineers, admitted that if the river traffic does not increase the improvement will not be justified, but has no doubt that it will increase greatly. Present developments, at Pittsburgh and elsewhere, forecast this definitely. The Ohio work will probably be completed within five years. A large and profitable business is being developed by the government barge line between St. Louis and New Orleans. As late as 1920 farmers lost heavily because of a railway glut. The effect of lowered export rates in certain cases, as wheat (whose price is fixed by the Liverpool market) affects not only the exported wheat but also that sold here; but the domestic consumer pays the extra return to the farmer, so that the economic gain is limited to the amount exported.

Past-president C. F. Loweth, of the Chicago, Milwaukee & St. Paul Ry., after mentioning the general decline in water carriage, on the upper Mississippi and elsewhere, quoted Col. Ashburner to the effect that the losses in operating Warrior River transportation have been "staggering." He declared that the Panama Canal is working injury to the industrial development of the Pacific Coast, illustrating this by instances of commodities imported from Europe in competition with local products. A new channel of transportation, he concluded, may result in disadvantages.

Dix River Dam—L. F. Harza, engineer of the 275-ft. rock-fill dam over the Dix River, now nearly completed, described the design and construction of the work before the Power Division. The construction of the dam was described in *Engineering News-Record*, April 2, 1925, p. 548. The steep slopes of the dam, up to 1:1 at the top, and the heavy rubble pavement with reinforced-concrete slab surfacing of the upstream face, characterize its design as remarkably bold.

Spillway capacity to an amount six or seven times as great as the largest recorded flood is provided by a channel alongside the dam. C. E. Grunsky called attention to the fact that failures of rock-fill dams in the past (Walnut Creek; Lower Otay) have resulted from overtopping due to insufficient spillway capacity, and not from initial failure of the embankment itself.

Waterways Division—The organization of the new Waterways Division was effected at a meeting under the chairmanship of S. Van Pelt, with Major Gordon R. Young acting as secretary. An executive committee consisting of Gen. Harry Taylor, Prof. C. M. Spofford, Col. C. W. Kutz, M. G. Barnes, and John F. Coleman was elected and a constitution was adopted.

Stream Pollution and Purification—Four papers on stream purification were read before the Sanitary Division, with little discussion. Dr. W. H. Frost, of the Public Health Service, presented "A Review of the Work of the U. S. Public Health Service in Investigations of Stream Pollution." Two papers on the rate of de-oxygenation and the rate of atmospheric re-aeration of sewage-polluted streams were read by E. J. Theriault and H. W. Streeter, while J. K. Hoskins, also of the Public Health Service, gave the results of quantitative studies of bacterial pollution and natural purification in rivers of Ohio and Illinois.

New Jersey Plans Arterial Road from Holland Tunnel

Fifty-Foot Paved Road Through Jersey City, Newark and Elizabeth Estimated to Cost Over Two Million Dollars a Mile

CONSTRUCTION of the vehicular tunnel across the Hudson River at New York City calls for an arterial highway some 13 miles long to collect and distribute the tunnel traffic through Jersey City, Newark and Elizabeth. Traversing the communities it does, this road in the nature of things has few of the characteristics of the normal highway. Structurally it is a succession of viaduct, subway, tunnel and city streets, with a standard width of roadway of 50 ft. and the heaviest kind of surfacing. Furthermore it is designed so as to have no grade crossings. In the matter of traffic this highway must be, from the beginning, one of the most crowded ways of the country. Its cost will be upward to two million dollars a mile. Because of all these things and because the letting of contracts will begin in a month or two there is special interest in an account of the planning and of the structures planned.

A map of the tunnel and of the territory traversed by the new highway is shown as Fig. 1. The route indicated is tentative except for the small but expensive section from the tunnel ends in Jersey City to Hudson Boulevard on the heights which is fairly definitely located for early construction (Fig. 2). The whole route is one laid down by an advisory board of engineers which reported late in January, 1924. From the Jersey City heights (Hudson Boulevard) to Elizabeth there may be any change in location which the traffic and engineering studies in detail, now in progress, may show to be best. This final location is a problem for separate discussion—the present article covers only the location and design problems of the section west from the tunnel ends to Hudson Boulevard, about 3,500 ft.

Location Studies—Two physical facts have first to be got in mind. One is the yards of the Erie R.R. and its cut and tunnel through the ridge. The other is the ridge itself which separates the low level along the Jersey City waterfront and the Newark meadows at

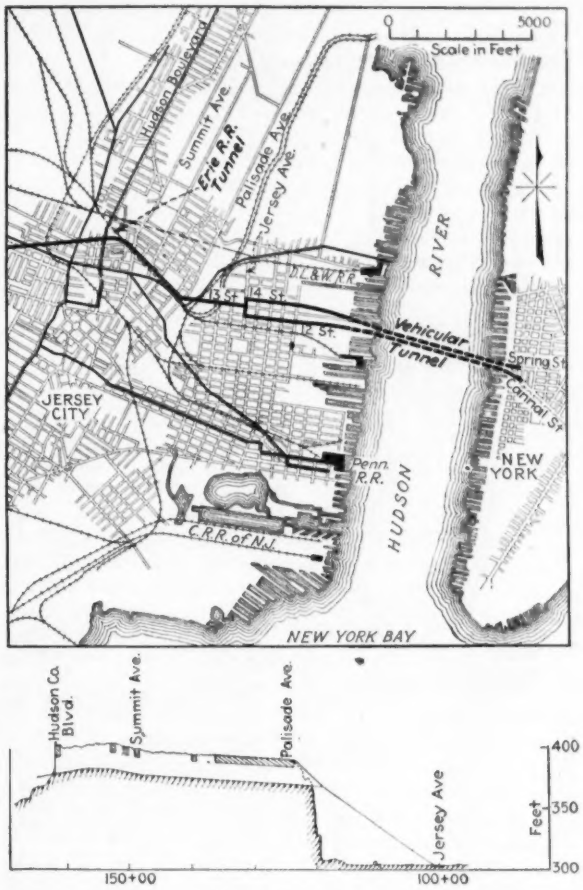


FIG. 2—PALISADE SECTION OF PROPOSED TUNNEL APPROACH

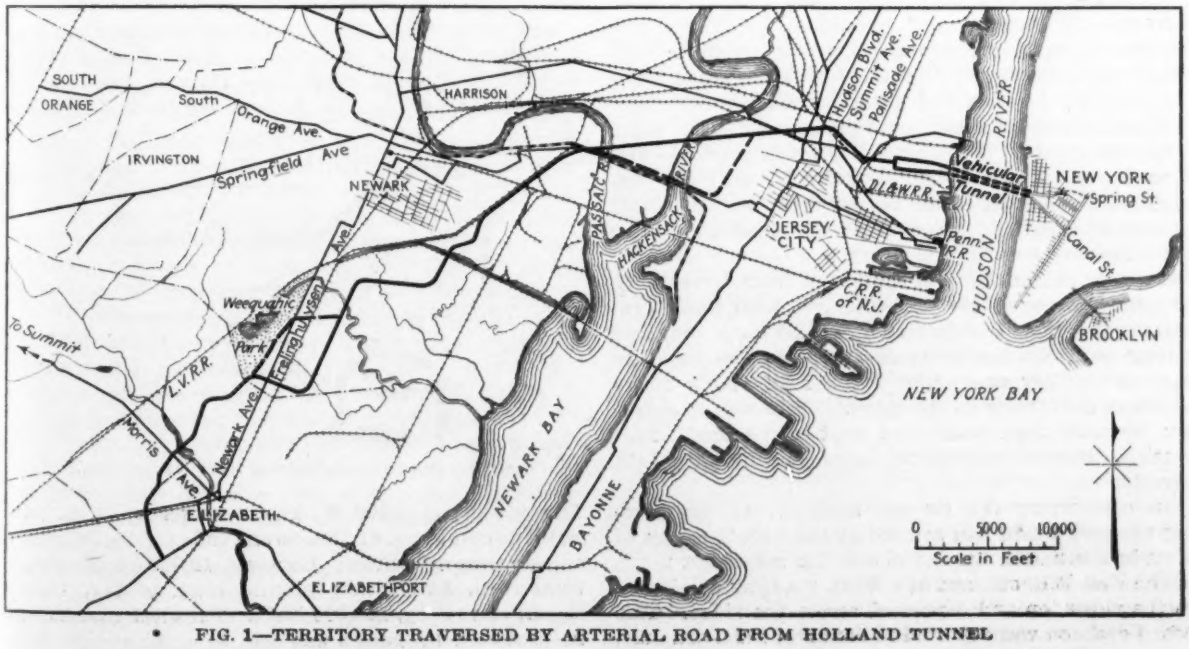


FIG. 1—TERRITORY TRAVERSED BY ARTERIAL ROAD FROM HOLLAND TUNNEL

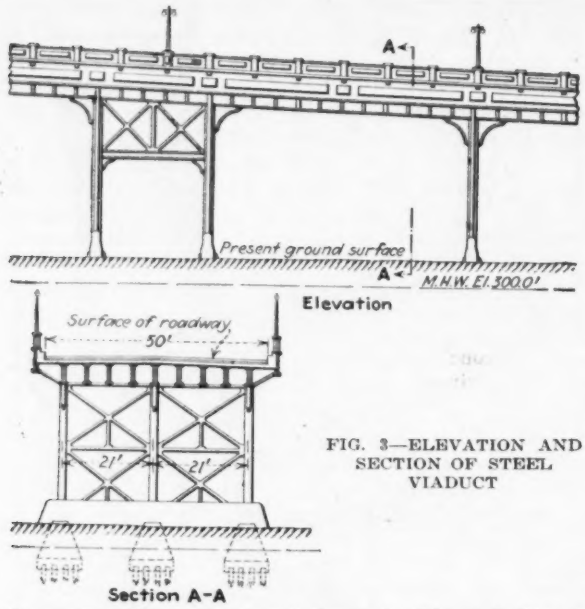


FIG. 3—ELEVATION AND SECTION OF STEEL VIADUCT

the west. The Erie tunnel shown in Fig. 1 indicates the width of this ridge. Except one or two lines which go around its southern end, all railways coming to New York from the west pass this ridge by deep cuts or tunnels. Likewise it was a barrier which the new highway must overcome and without interference with the crossing rights held by the railways. Here, there was the first location and design problem.

The outstanding traffic considerations affecting plans were three: (1) Provision for through traffic to and from the main road system beyond Elizabeth; (2) provision for the local traffic to and from the industrial section of Elizabeth, Newark and the meadows district about Newark Bay and the rivers, and (3) provision for the ridge traffic north and south and from Jersey City heights. In respect to the section of road being considered these traffic requirements called for a wide and strong roadway and as moderate grades as could be managed. They also called for a road giving ready access to the streets on the ridge. There was of course one certainly fixed point—the start of the road. This must be between the twin tunnel ends on 12th and 14th Streets.

In considering the general situation as described, the advisory board had arrived at the tentative plan of a route along 12th St. and across the ridge just north of the Erie R.R. cut, and of a 50-ft. roadway on viaduct to the ridge top and depressed across the ridge. This board decision was reported in January, 1924. In July, 1924, detail studies were begun under Fred Lavis as engineer. The 12th St. route was studied and also one on 13th St., and in September, 1924, the 12th St. route was recommended.

Conference with the city officials and those of the Erie R.R., next in order, brought complications. The 12th St. route was objected to by the railway officials as interfering with certain contemplated yard buildings. They also objected to the location of a cut across the ridge which in any way would interfere with removing the present tunnel top or widening the present cut. They asked removal of the route to 13th St. or 14th St. In turn the Jersey City officials objected to the 13th or 14th St. routes as more destructive of taxable values, and in general objected to any open cut across the ridge. To meet these objections a new route along 13th St. and across the ridge on a center line parallel to and 125 ft. north of the center line of the four tracks in the Erie R.R. cut was adopted Dec. 17, 1924. The Erie R.R. asks now that the ridge crossing be moved 15 ft. further north and further studies are under way.

Structures Planned—The physical characteristics of the two lines (12th St. and 13th St.) are not much different. The elevation to be overcome is the same, the grade is the same and the structure types are the same. However, the 13th St. line is 5 ft. larger and has 5 deg. more curvature than the 12th St. line. As stated, the structure types are viaduct and subway and covered depressed road.

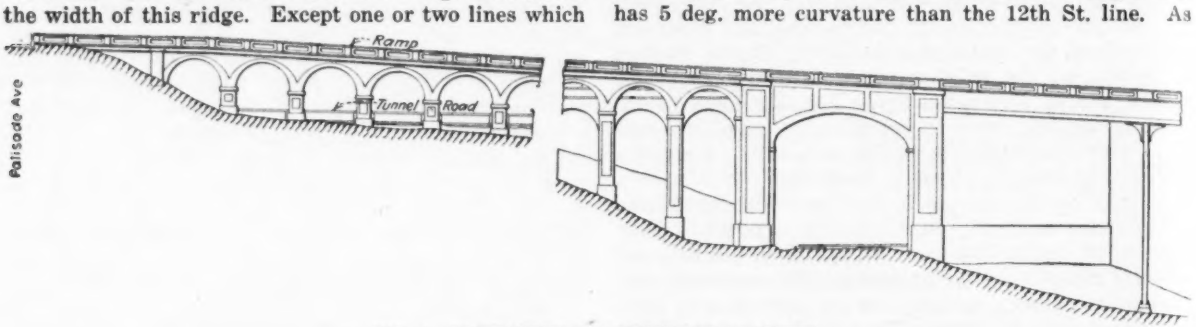


FIG. 4—ELEVATION OF CONCRETE VIADUCT

Beginning where the tunnel roadways come to street level there will be a steel viaduct of the general design shown by Fig. 3 for about 1,850 ft., and then concrete viaduct as shown by Fig. 4 about 450 ft. to the hilltop.

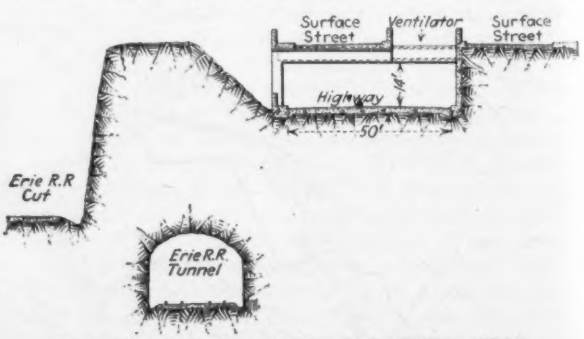


FIG. 5—SECTION SHOWING DEPRESSED ROAD

This viaduct of 2,300 ft., known as section 1, is estimated to cost about $1,750,000 and calls for the following approximate quantities: Concrete, 12,000 cu.yd.; structural steel, 3,000 tons; granite block paving, 10,000 sq.yd.; and piling, 165,000 lin.ft. The steel viaduct will be protected by gunite and will have a concrete floor with granite paving.

There is, however, in the road plan, Figs. 4 and 5, of the concrete viaduct section, to be noticed the ramp arrangement for connecting the level of the tunnel road with the surface streets. By these inclines and others similar where the depressed roadway comes out on the

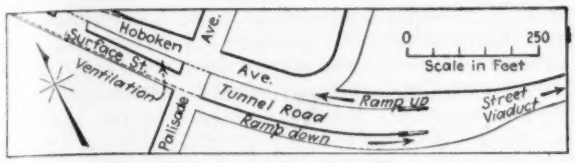


FIG. 6—RAMPS BETWEEN TUNNEL ROAD AND STREETS

west slope of the ridge, the tunnel road receives and distributes traffic from and to the road system on the ridge. The depressed roadway itself is a covered structure with a roadway along the roof as indicated by Figs. 5 and 6. With this construction there will be free north and south street communication.

The depressed road section is 1,200 ft. long and involves 70,000 cu.yd. of excavation, 10,000 cu.yd. of concrete and 1,200 tons of structural steel. Its estimated cost is $1,500,000. Neither this estimate nor that for the viaduct section includes land and property damages. It may be noted here, incidentally, that the estimate by the advisory board for the complete line to Elizabeth was about $28,000,000 on the basis of tunnels crossing the Passaic and the Hackensack rivers.

Direction—The tunnel road planning is under the direction of the New Jersey Highway Commission, W. G. Sloan, chief engineer. Fred Lavis is the engineer having special direction of design and construction with a force of engineers and headquarters at Jersey City.

Regional Planning, Garden Cities, Zoning and Traffic

Main Topics at International Town, City and Regional Planning Conference—100 Delegates from 20 Foreign Countries

A HUNDRED men and women from 20 or more foreign countries and some 500 additional from 34 American commonwealths were in attendance at the International Town, City and Regional Planning Conference held in New York City, April 20-25. This conference was organized by the International Federation for Town and Country Planning and Garden Cities and the Conference on City Planning (U. S. A.) in conjunction with the American City Planning Institute, the American Institute of Architects, and City Planning Division of the American Society of Civil Engineers.

Of the large number of papers and addresses presented at the conference many were by noted foreign delegates. Most of the papers fell under four heads: The traffic problem; planning unbuilt areas; better distribution of people and industries; and zoning in practice.

Progress in Planning—In the United States today, stated George B. Ford, president of the National Conference on City Planning and of the American City Planning Institute, "city planning is active in 22 out of the 48 states," while it is "well launched in all but 6 of the remainder." Altogether there are over 300 city planning and zoning commissions in the United States. Zoning ordinances have been adopted by more than 325 cities and towns up to the end of 1924.

Traffic Problems—The first of the group of papers on this subject was by Arthur S. Tuttle, chief engineer, Board of Estimate and Apportionment, New York City, who dealt with city planning as the solution of the traffic problem. Auguste Bruggeman and Jacques Greber, professors at the Paris School of Higher Civics, opened their joint paper by saying that the "present vital problem of traffic in every modern town is largely the result of an inadequate or an insufficient street plan." It was suggested that street railways "should disappear from the congested centers" of cities and that street railway tracks, "heavy autobuses and carts should not be tolerated in roads where there is intense traffic."

Of 13 conclusions in a paper by Morris Knowles, consulting engineer, Pittsburgh, Pa., these suggestions for relief of street traffic may be noted: Segregation of different kinds of traffic; loops around central business districts and bypassing through traffic around cities.

A joint paper on arterial roads was contributed by G. L. Pepler, past president, British Town Planning Institute, and Dr. Joseph Brix, professor at the Technical High School, Berlin-Charlottenburg. Practice in various parts of the world was summarized briefly and many data on design given, including widths for various classes of arterial roads. For streets more than 60 ft. in width, it was suggested that the water, gas and other mains be duplicated on both sides of the street.

Spice was thrown into the proceedings by Alvin Macauley, president, Packard Motor Car Co., Detroit. Among other things, he said "It must be admitted that we, the automobile industry, have been so concerned with 'next year's model' that we have forgotten that it would have to be run on last generation's streets—and generally on streets built on the 1682 model when William Penn laid out the first checkerboard street plan for Philadelphia."

Planning Unbuilt Areas—The message from Norway was brought by Prof. Verre Pedersen, who stated that in that country "the great majority of buildings are of wood, predominantly so in the new small towns. This induces an extensive use of single houses and very open planning principally on account of the danger of fire." Emphasis was laid on the need for considering the small town in its relation to the surrounding landscape and the formation of the land.

At the close of a paper on "The Control of the Subdivision of Land Into Building Lots," Robert Whitten, city planner, Cleveland, Ohio, said: "Our scattered suburban growth greatly increases the cost of utilities and of municipal service and administration. It is a question whether it would not be more economical for the city to pay out of its general funds the entire cost of street improvements within subdivisions needed for expansion, if thereby it could secure a building up of the areas immediately adjacent to existing built-up areas rather than a scattering of houses over many square miles of area that will not be largely built up for years."

Better Distribution of People and Industries—A German and an Englishman gave the opening papers on this subject. R. Heiligenthal, Berlin, said that although decentralization may be effected, the process must be different for "heavy industries" and "mechanical industries." The heavy industries may be located in garden cities or villages, but such mechanical industries as instrument and machine making cannot so readily be moved away from the center of cities, partly because

they demand skilled workmen and have fluctuating seasonal markets, and partly because the women of the families are likely to be engaged in light industries carried on in the cities. The location of "big mechanical industries" should be as far as possible established in the outer suburbs, while between the sites for these works and the inner city large green spaces should be set apart for the recreation of those who must live in the inner city." Finally: "The absolute sovereignty over the location of industry and trade is only possible by controlling or influencing railway facilities."

Continuing this general subject, Dr. Raymond Unwin, chief architect to the British Ministry of Health, stated that town growth by "accretion around a circumference tends to produce a maximum of confusion, and that single urban units should be limited in size and defined in form, and that when the limit is reached further growth should be provided for by new units of urban development, stimulated around suitable secondary centers, and in turn planned to allow for their expansion to the desirable limits."

How to plan the laying out and government of regions was taken up by Alfred Bettman, a lawyer of Cincinnati, and Thomas H. Reed, director, Department of Government, University of Michigan. The boundaries of a region, Mr. Bettman suggested, should be governed in part by economic conditions and in part by the ready correlation of public utilities. County planning or planning within counties is authorized by statute in Ohio, the County Board of Supervisors to appoint representatives of non-urban districts and the local planning boards of the urban districts to designate their representatives. Mr. Bettman warned against the apparent tendency in the United States to use the county as a planning unit since the county in general is more arbitrary and illogical an area than that of the cities. Mr. Reed suggested that a new unit of local government be created, to be known as the region and to vary with local conditions and to have respect also for local traditions. A council of nine to be elected from local districts might be provided.

New York Regional Plan—An evening was devoted to the work accomplished and under way by the Russell Sage Foundation Committee on a Plan for New York and Its Environs. The area included, said Thomas Adams, general director, Regional Plan of New York and Its Environs, lies in three states, embraces 3½ million acres, 400 communities, and a population of 9,000,000 distributed at a rate of 950 persons per acre on the east side of the Borough of Manhattan to 4 families or 16 persons per square mile in Putnam County. The six divisions of this area assigned in 1923 to as many city or regional planners are now being restudied by counties. William J. Wilgus, consulting engineer, New York City, presented a lengthy paper on "Transportation in the New York Region," in which he sketched an outer belt railway and boulevard; twin inter-connected inner-belt railways and boulevards to bring all trunk-line passenger service into direct touch; a unified passenger rapid transit system; an internal freight distribution system under unified control, with universal "store-door" collections and deliveries; internal waterways connecting all parts of the harbor; recreational areas; industrial and port developments laid out on modern lines among pleasing surroundings and served without discrimination, by all carriers. In discussing Colonel Wilgus' paper, Daniel L. Turner, consulting engineer, Transit Commission, New York City, dealt chiefly with methods of financing transporation for the New York region, showing how taxes and bonds in New York City have increased in the last 25 years as the square of the population and asking what the bonds and taxes would be when the population reached 20,000,000. Mr. Turner proposed, as a method of financing transportation facilities, pay as you go, based on assessments for benefits. The plan of financing rapid transit in New York City in the past, Mr. Turner said, has given all the benefit of the improvements to the property benefited. The recreational plan of Westchester County (meaning the park and parkway systems) was described by Jay Downer, consulting engineer and executive, Westchester County Park Commission, New York.

Zoning—Besides conducting a series of round table conferences at every morning, noon and evening meal, not taken up with other city planning subjects, Edward M. Bassett, counsel, New York City Zoning Committee, presented a succinct review of the fundamentals of American zoning, with special reference to the vital importance of court review. One of the strong arguments for these boards, Mr. Bassett urged, is that without them property owners opposed to zoning take cases into court on mandamus and contest the validity of the zoning ordinance, whereas with boards of review the courts will not ordinarily entertain mandamus proceedings but insist on certiorari. Wherever mandamus is the only recourse for the property owner who thinks his rights endangered, zoning has gone to pieces, Mr. Bassett stated. The Board of Zoning Appeals is or is supposed to be made up of experts and when the case is taken from this board to a court, the latter body considers the case with the knowledge that the property owner has had an opportunity to be heard. In the discussion of this paper there were two lines of criticism: (1) Mr. Bettman stated that in the practice of the Ohio and some other courts certiorari is not recognized, while (2) other speakers stated that in California and some other municipal home-rule states boards of zoning appeal and review were regarded as an infringement on the home-rule law.

A lengthy and valuable paper with the title, "The Influence of Zoning on High Buildings and Street Traffic" and the subtitle, "The Relation of Building Bulk to Street Traffic," was presented in summary by Ernest P. Goodrich, consultant on the traffic plan of New York and Its Environs. Many statistical and other data were presented. A somewhat elaborate mathematical formula was worked out in the paper for use in determining the optimum average residence building height in view of "the facts that high buildings cost more to construct and to operate than do low ones and that a city of any assumed size (building bulk) will occupy less area and thereby involve less lengthy and less costly vehicular operations if the buildings are high than if they are low."

A Plan for the State of New York—At a joint session held with the American Institute of Architects, Clarence F. Stein, chairman of the New York State Commission of Housing and Regional Planning, presented a paper on "A Plan for the State of New York." The commission named is considering ways and means for "a more efficient distribution of" the population of the state. Thus far, an actual plan has not been attempted, but data for the plan are being gathered. Among the facts thus far established and presented graphically are that "from 1850 on county after county"

in New York State has "joined the column of shrinking population" so that in the period from 1910 to 1920 "only 3 out of the 55 counties outside of the New York area have grown, except in 1 or at most 2 industrial cities, while 29 have actually fallen off" in population, "even including the cities." Since 1880, the rural population has shrunk from 50 to some 12 per cent of the total population of the state.

Undermining Causes Failure of French Landing Dam

Part of Earth Embankment in New Dam on the Huron River in Michigan Washed Out Before Filling of the Pond Was Completed

On Monday, April 13, a considerable flood was caused in the lower Huron River valley near Detroit, Mich., by the undermining of a portion of the embankment of the French Landing Dam of the Detroit Edison Co. The first press reports were much exaggerated and stated that the new dam of the Ford Motor Co. at Flat Rock had been washed out by the flood coming down from French Landing. The following description of the failure of the French Landing dam was prepared in the office of Gardner S. Williams, consulting engineer, Ann Arbor, Mich., who designed the dam and supervised its construction.—EDITOR.

HURON RIVER, which at the site of the French Landing hydro-electric plant has a drainage area of about 825 square miles, flows through a glacial valley, its normal channel being from 100 to 150 ft. wide, and at bank-full stage is from 5 to 6 ft. deep. The valley above, and for about 12 miles below, the plant, varies in width from 1,000 to 2,500 ft. and is inclosed by steep bluffs rising from 20 to 35 ft. above low water. About 14 miles below French Landing is the Flat Rock hydro-electric plant of the Ford Motor Co.

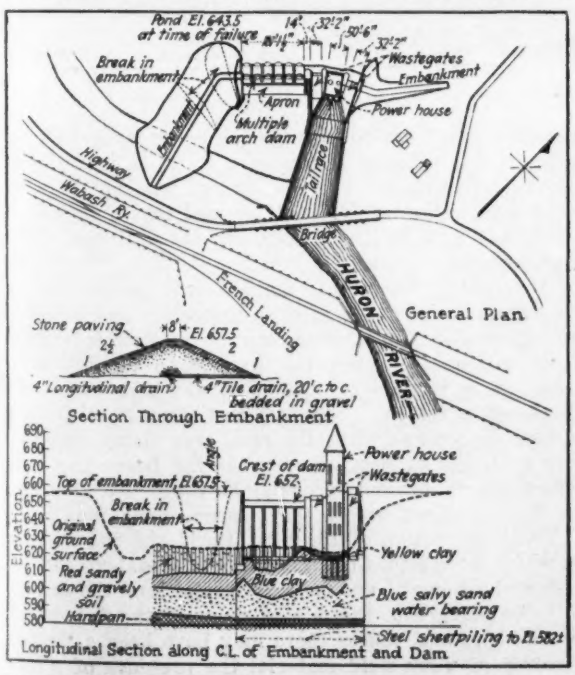


FIG. 1—PLAN AND ELEVATION OF FRENCH LANDING DAM

and below that the valley broadens and ultimately spreads out into the marshes which border upon Lake Erie at the river's mouth.

A general plan of the French Landing plant together with an exaggerated cross-section of the valley along the center line of the work is shown in Fig. 1. It will

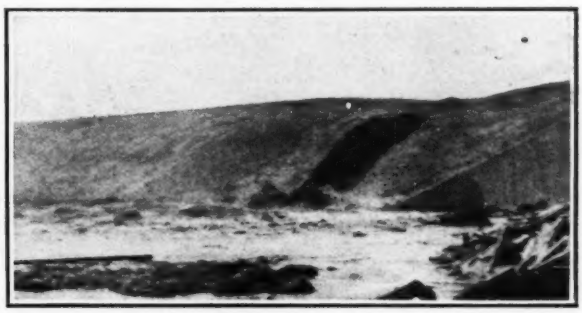


FIG. 2—AN EARLY STAGE OF THE WASHOUT

be noticed that a highway and the Wabash Ry. main line cross the river on bridges just below the plant.

Construction was commenced by the contractors, A. Phelps & Sons, of Knoxville, Iowa, in June, 1924, and the filling of the pond above the dam was begun on Feb. 18, 1925.

The water was raised gradually until it reached El. 646, a level 6 ft. below the spillway crest. Slight flows of water appeared in the underdrains at the toe of the embankment as the water rose, but no notable increase in quantity appeared until the morning of April 4, when with the pond at El. 643 the two drains at the angle of the embankment began flowing full, the water being practically clear and carrying no visible material. These underdrains are of 4-in. sewer pipe laid in gravel with open joints, the lines being 20 ft. apart along the center line of the dam. They all connect to a header running along the center line throughout the length of the structure. The angle in the embankment caused two of the drains to discharge within about 5 ft. of each other at the toe of the slope. The drains were laid on the top of the natural surface and their elevations varied from 625 at the west down to 622 at the angle.

As an examination of the situation on April 9 indicated no decrease in the flow through these drains, the pond was ordered drawn 5 ft. at a rate of not more than 2 ft. per day, and weir boxes were ordered to measure the flow through the drains. The box on the five drains at the west end was installed April 10 and the record shows no increase of flow up to the time of failure. The single weir intended to gather the rest of the discharge had not been completed when the break occurred. From observation of the discharge at the drain outlets it did not appear to the resident engineer that the flow had increased over that existing April 9, though some observers thought otherwise.

By Monday, April 13, the pond had been drawn down to El. 643.4, and the crew was still working on the lower weir box. At 12:05 p.m., just after the crew had left their work for lunch, a flow of water consisting of two small streams was noticed coming out at the angle about 2 ft. above the toe of the embankment. The two waste gates, 33 ft. 2 in. wide, with sills at El. 640, were immediately opened, which operation was completed at 12:12, the three 5-ft. butterfly gates under

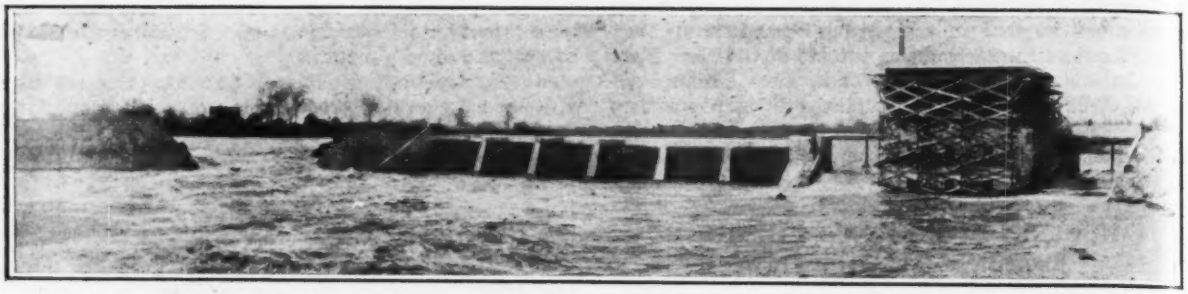


FIG. 3—THE WASHOUT AT ITS CREST

the power house being already open, and the pond was drawn as rapidly as possible. An early view of the break is shown in Fig. 2. Fig. 3 shows the condition at about the crest of the flood.

The erosion began with an approximately circular opening at the downstream toe, funnel shaped in the interior through which the water boiled up from below and rapidly enlarged the passage, earth falling from above choking the outlet so that it was soon filled with water. The first photograph was taken at about 12:15, but is not appreciably different from Fig. 2 taken about 5 minutes later. The crest of the embankment broke at 12:40.

sand but with enough cementing material to enable it to stand practically vertical in the banks of channels scoured through it by the water. It showed little or no tendency to flow when wet, and in the test borings it was reported as non-water-bearing. An attempt of the contractor to use it as a source of water for concrete mixing by making an excavation in it near a water course, and trying to pump a supply from it resulted in failure as the material under moderate heads would not transmit water in appreciable quantities. While as a foundation for the masonry parts of the plant it was considered unsafe, and these structures were carried to and into the underlying clay and a

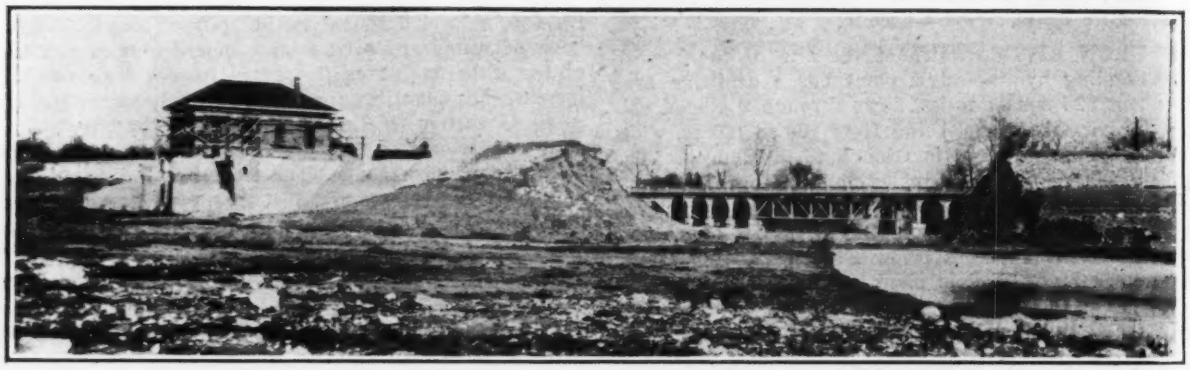


FIG. 4—CUT THROUGH THE EMBANKMENT LOOKING DOWNSTREAM FROM THE DRY POND

The flood crest at the downstream side of the dam occurred at 3:15 p.m. and was at El. 635.5 or 16.5 ft. above normal low water.

At the Ford Motor Co.'s dam, at Flat Rock, 14 miles below, the crest passed at midnight with a head of 3.2 ft. on the dam, and a rise of tailwater of 10.4 ft., the pond having been somewhat below the crest when the flood arrived.

The quantity of water discharged, determined from reservoir contours, was 2,900 sec.-ft. from 12:05 to 1:15 p.m. and 32,800 sec.-ft. from 1:15 to 2:15 p.m.; after that it fell off rapidly.

A gap was eroded in the embankment measuring 135 ft. across the top and 55 ft. at the water line at El. 620 and with its bottom on the clay at El. 811.

Outside of the scouring out of about 18,000 cu.yd. of material from the embankment and underlying soil, the damage was very slight.

The cause of the washout is plain enough although it was not anticipated. The stratum upon which the embankment was founded varied in thickness between 10 and 20 ft. and was underlaid by a bed of blue clay. It was an alluvial deposit composed mainly of a fine

sheetpile cutoff driven through the lower water-bearing sand, it was thought unnecessary to do so in the case of the embankment. As its surface was but 3 or at most 4 ft. above tail-water, it seemed that underdrains would add little to its stability, and the drainage of the embankment was carried over its surface. The angle of the center line of the embankment caused two of its drains to discharge in close proximity and afforded an opportunity for a concentration of flow into them from underneath when the foundation became saturated, as a portion of it undoubtedly did, under the increased pressure. The fact that frost was coming out of the ground while the pond was rising obscured any evidences of seepage upon the flat below the dam, which otherwise would probably have directed attention to the conditions before they became dangerous.

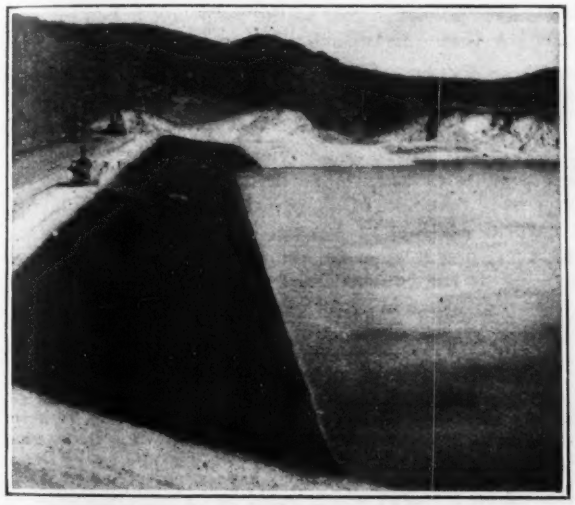
The construction of the bank itself and the manner in which it withstood the scouring of the water (Fig. 4) reflects high credit upon the contractor, and the failure is to be charged to the misjudgment of the foundation by the engineer, unless there may have been a limited stratum of more fluid material the presence of which was not discovered by the borings.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Fuel and Road Oil Applied as Binder on Earth-Fill Dams

AFTER the completion last year of Encino dam, one of the several earth-filled structures used to create storage capacity for equalizing distribution on the Los Angeles aqueduct system (*Engineering News-Record*, April 3, 1924, p. 585) it was decided that the upstream face should be coated with oil to prevent damage from wave action. Accordingly, hot oil in tanks was hauled out on the dam and sprayed on with a hose. The first applications were light oils and afterward heavy asphalt was put on, with total penetration of 9 in.



ROLLING OPERATIONS ON UPSTREAM FACE OF ENCINO DAM

The slope of the dam on which the oil was applied was 2:1 and the area covered was 119,081 sq.ft. The dam had been built by the dry-fill process using shale, sandstone and gravel taken from adjoining borrow pits.

After the oil application had been finished the face of the dam was rolled with a steel roller, 3 ft. in diameter and 5 ft. long, supporting a platform, carrying a rock load weighing about one ton. The rolling was accomplished by using a wagon loaded with rock and standing on the crest of the dam, as anchor for a sheave leading from the steel roller to a steam roller moving along the crest of the dam. As the rolling of one strip was finished the wagon could be moved ahead the width of the steel roller and another strip rolled. Detailed cost figures on this operation are given in the accompanying table.

Subsequent to the Encino oiling a 5-ft. strip on the upstream face of the lower San Fernando dam was also oiled last October. In this case, however, six applications were made on six successive 1-in. layers of gravel of a size that would pass a 1-in. screen, this treatment being applied between the top of the concrete paving and the crest of the dam.

These successive gravel layers were not rolled but simply spread as evenly as possible with shovels and then hot oil was put on with a spray as in road work, using 70 deg. gravity road oil. The oil used averaged 0.16 gal. per square foot per layer. The only rolling and sanding was done after the sixth or top layer had been applied. The slope of this dam is 2½:1.

OILING COSTS ON ENCINO DAM

111,269 gal. fuel oil (16 to 18 gravity)	$3,493.95
11,249 gal. road oil (70 per cent asphalt)	875.25
Overtime for spreading fuel oil, 119 hours	99.00
Overtime for spreading road oil, 22 hours	18.30
Labor for spreading oil and rolling	
3 days @ $5	16.50
55½ days @ $4	221.50
31½ days @ $3.50	108.94
Total cost	$4,833.44
Unit cost per square foot	$0.0406
Average gallons fuel oil per square foot	0.93 gal.
Average gallons road oil per square foot	0.094 gal.

This work should be done during warm weather, it is pointed out, to secure the best penetration. On the San Fernando dam the hot oil had to be hauled more than 20 miles and the weather was cool and windy during the application so that conditions were not ideal.

The oiling on both dams was done under the general direction of William Mulholland, chief engineer, Water and Power Bureau, city of Los Angeles.

Eliminating Slipperiness and Glare From Concrete Sidewalks

BY C. L. B. ANDERSON
Norfolk, Va.

SLIPPERINESS and glare are often cited as objectionable features of concrete sidewalks as usually constructed. Both of these, however, can be easily overcome, and at a minimum of expense and labor.

A satisfactory roughening of the sidewalk surface can be obtained by applying an acid wash. In the case of sidewalks which have been laid for some time, it is necessary to clean thoroughly the surface to be treated by washing and wire brushing. The acid wash is then applied with a whitewash brush. The acid solution should be made up of one part commercial hydrochloric acid to two parts water. It takes the acid wash from thirty to sixty minutes to etch the surface to a satisfactory roughness, depending upon the age of the concrete, the temperature, etc. A much better surface can be obtained if, during the time the acid treatment is in progress, the surface of the concrete be brushed with long-handled deck brushes having stiff palmetto fibers. When roughened sufficiently the surface is thoroughly washed with a hose. The treatment of a newly-laid sidewalk can be more expeditiously done.

Objectionable glare can be eliminated if the top coat is made from a dark sand or stone dust and the surface, after setting, is treated with a similar acid wash.

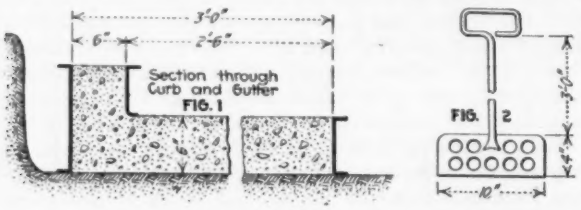
The cost of the acid treatment varies greatly with conditions, but specially with the size of the job. If the project be of sufficient magnitude to get a gang of workmen accustomed to the work and if sufficient acid is needed to allow purchase in bulk at wholesale

price, the cost should not exceed 3½c. per square foot. This cost is predicated upon a price of 2½c. per pound net for 20-deg. muriatic acid, purchased in 180-lb. carboys (advantage being taken of the return value of the carboys), and with common labor at $3.20 per day.

Spader Insures Clean Finish to Curb Built Monolithically With Pavement

By R. R. Worsencroft
Former Resident Engineer, Morgan Engineering Co., Memphis, Tenn.

On A recent job in Arkansas, specifications required the placing of an integral curb and gutter section, using the same mix as was required for the actual street construction. As the usual method of curb construction is to use a core of concrete, with a facing or plaster coat of mortar, the method developed for



SMOOTH CURB FINISH MADE WITH SPECIAL SPADER

laying this type of curb may prove of interest to some contractors.

The shape and setting of the forms for the curb and gutter are shown in Fig. 1. The difficulty was, of course, to eliminate the stone pockets and voids along the vertical surfaces of the forms, particularly on the face of the curb. As the mix used—1:2:3 with a 1-in. stone—was rather coarse for this work, and the only finish allowed after removing the forms, was a thin wash coat, this difficulty took on a rather serious aspect.

Various methods were tried. The amount of sand in the mix was increased, the size of stone was decreased to ½ in., the amount of spading along the vertical sides was increased, wet and dry mixes were tried, all with but indifferent success. Finally a type of spader, which gave good results, was devised.

A spading tool was developed as shown in Fig. 2. A blade about 10 in. long and 4 in. high, made of No. 12 gage steel, was welded to a ¼-in. steel handle long enough to enable the workman to stand erect when operating it. Inch holes were made in the blade as shown. These holes were essential, as it was found that without them the spader worked no better than the ordinary shovel.

The method of operation was as follows. The mix was modified to 1:2½:3. As soon as the forms were about half full the workman began spading the vertical sides. In using this spader, he would push the blade as far down along the face of the form as possible, and then tilt the blade into the wet concrete at an angle of about 15 deg. He would hold it in this position for a few seconds, to allow the water to run out through the holes onto the surface, and then remove the spader, tilting it back to the vertical as he did so. As the forms were filled, he would continue this operation, going over the same sections at least three times. Then the top was tamped, and the concrete was allowed to stand until it got its initial set, after which the forms were removed.

From Job and Office

Hints that Cut Cost and Time

It was found in removing the forms, which had previously been well oiled, that the most successful method was first to run a trowel along the vertical face of the curb, and then to slide the form along the face for a short distance before taking it away from the surface. The curb was then smoothed over and the corners rounded with a wooden trowel, and finally painted with a neat coat of cement mortar.

This method gives nearly as smooth a surface as in plaster curb work, and matches up better with the rough surface of the street. Its success depends wholly on continuous and careful spading of the vertical surfaces. While perhaps not as fast to construct as the plaster-faced curb, it has the advantage of not spalling off nor cracking as readily as the latter, and since it is made of the same mix as the roadway, it has greater strength than the ordinary concrete curb.

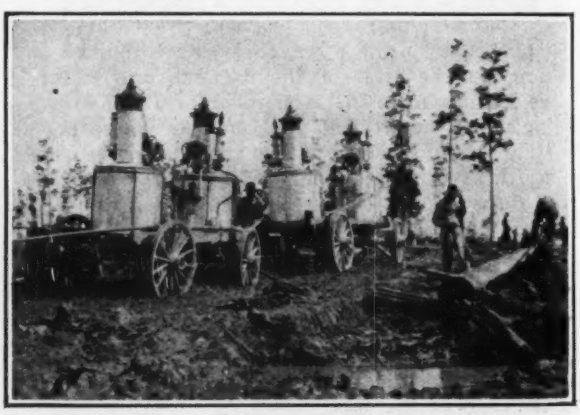
Acetylene Distribution on Welded Pipe Line in Texas

Distribution of acetylene supply for oxwelding pipe lines has, it is believed, sufficient general interest to take note of an experience met with in laying a natural gas line in Texas. G. O. Carter, consulting engineer, presented a paper on the subject at a recent meeting of the International Acetylene Association, an abstract of which is here presented.

The president of the Magnolia Gas Co., F. M. Lege, Jr., who had made a very careful study of welded pipe lines, . . . suggested that we try to find some way of cutting down the number of teams and the labor required for this operation. As a result of the study it was decided to keep the generators at a fixed position during working hours and supply acetylene to the welders by using a small pipe line.

Previous practice had been to have a portable generator mounted on a wagon which would be hauled from welding station to welding station by a team of mules. The single generator would supply four welders, when working on pipe with ⅜-in. walls. The average welding crew consisted of four such gangs working from individual generators, and five other men making tiein welds, using portable equipment.

In fair weather there would be a team hitched to each generator wagon; two teams to the portable welding outfits, and two teams on tank wagons hauling water for the generators. If the weather should become bad extra teams would be required for moving the generators. . . .



FOUR ACETYLENE GENERATORS FEEDING INTO ONE DISTRIBUTION LINE ON TEXAS WELDING JOB

From Job and Office

For Contractor and Engineer

Generator wagons were moved (after working hours) by tractors or teams, whichever happened to be most convenient. Some time during the day the head generator man walked ahead far enough to spot a suitable site for the next setup. He would then walk back to locate and mark a suitable road for moving the equipment. By a little planning it soon became possible to move the generators in an hour.

After a study of the volume of acetylene required for 16 welders, it was decided to use 1½-in. pipe for the supply line. At first this was made up in 100-ft. sections, but it was shortly decided to handle it in lengths of 200 ft. Brass outlet plugs were bronze welded to the steel pipe at approximately 17½-ft. intervals. No valves were used on these outlets—they were merely closed with a cap nut. At each end of the pipe a stopcock was used to prevent the loss of acetylene and mixing of air. Connections were made by means of common unions.

The procedure for handling the acetylene pipe line is as follows: After the welders have passed a section, the joint is broken and the front end of the pipe is tied to a wagon (sometimes to a single-tree). A team of mules would then drag the pipe to the front end of the acetylene pipe line where it would be connected up. One team and one or two men are required to move and keep the acetylene supply line in condition.

In the old practice of using single generators, each one with its own team, it was necessary to have a generator man to operate each generator. Under the new plan, with four generators in a fixed position, one generator man and one helper easily took care of all.

When it was decided to use one acetylene supply line with several generators feeding it, there was much doubt as to the regularity of the feed from the generators. It was the belief of nearly everyone familiar with the problem that one generator would tend to carry too much of a load and the others would be working below capacity. In an effort to control the flow of gas from the generators, four flow meters were ordered for the first installation, but these were so low in capacity that they could not handle the volume of gases. In the meantime it was found that the problem was not as serious a one as anticipated. Six sets of four generators each operated for weeks at a stretch with no trouble from this source.

When generators were moved singly after each series of welds, the welders would collect their equipment, and place it on the generator wagon; then when they had reached the new welding station would uncoil their hose and get set for the next joints. When using the acetylene supply line, the welders disconnect the oxygen regulator from the oxygen cylinder and the acetylene hose from the acetylene line, and then carry their equipment to the next nearby station and hook it up. Welders therefore lose little time in moving their equipment, and they could be counted upon to put in a certain definite time of welding every day. Under the old plan when generator wagons would have difficulty in moving across wet fields or have to go around creeks and ravines a great deal of welding time would be lost.

Another advantage of the acetylene supply line, was that it permitted an entirely different grouping of welders. With single generators, four is the maximum number of welders who can get a steady supply of acetylene, but with three generators always feeding into a common line it has been found entirely satisfactory for as many as twenty-five welders using No. 10 oxweld heads to work off the system. This seems a little contrary to general acetylene practice, but it was watched very carefully by engineers who were familiar with the requirements for proper generation of acetylene. However, when No. 12 oxweld heads were substituted for No. 10 heads, the load was so heavy on the generators that two additional generators were added to one welding crew, which had much heavy welding work ahead.

It was estimated that the change in the method of supplying acetylene resulted in a direct saving of $25 per day per gang on the Magnolia Gas Co.'s welded line.

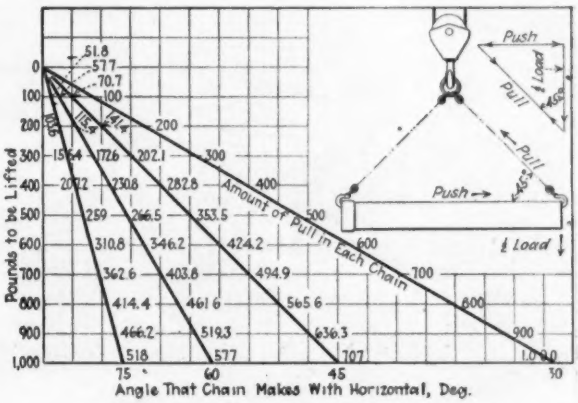
Stresses in Sling Chains

By J. P. Doolan

Superintendent, Maintenance Department, Morgan Engineering Co., Alliance, Ohio

SLING chains are frequently overloaded in handling loads less than the allowable safe working load for the chain. The above statement will be easily understood from the following consideration of the manner in which sling chains are used many times, by those who do not appreciate the mathematical principles involved.

From the sketch it is evident that the most convenient manner of attaching the chains to the load,



TENSION IN CHAINS FOR VARIOUS LOADS

which we will suppose in this case to be a section of cast-iron pipe, is by simply inserting the hooks in the ends of the pipe. It is easy to conceive of many other cases where this same condition might prevail and the inclination of the "hitcher" is to attach to the load in the easiest and simplest manner.

Let us assume the chains and section of pipe to be of such lengths to produce an angle of 45 deg. between the chain and the pipe as shown and that each hook is supporting half the load. There the load is exerting a force at the hook in a downward direction which is counteracted by a "pull" in the chain towards the crane hook and a "push" in the pipe in a horizontal direction.

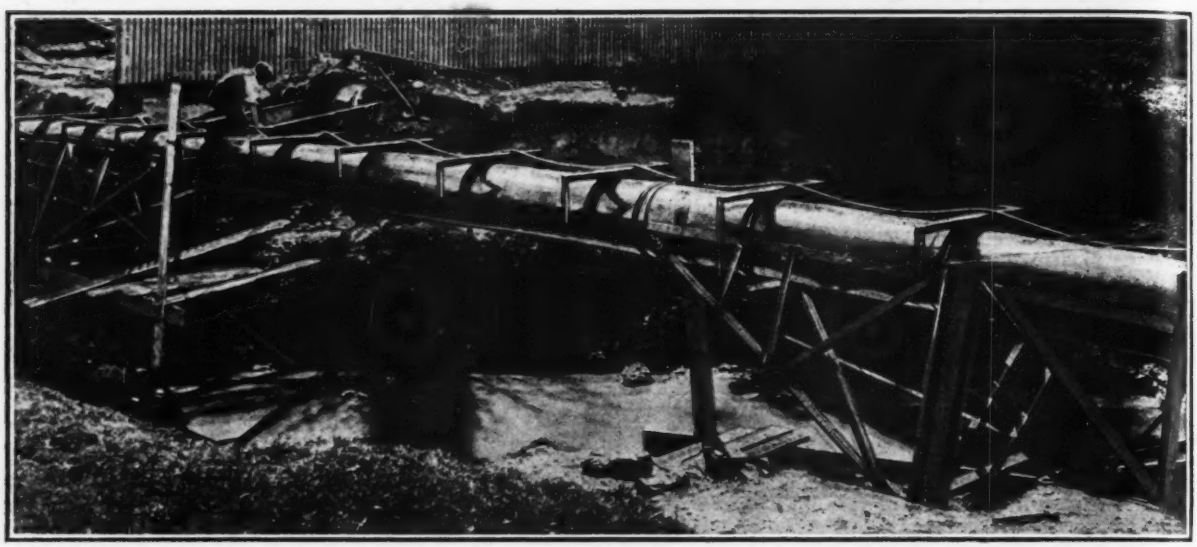
The magnitude of the "pull" in the chain and the "push" in the pipe can readily be determined by the use of the elementary principles of graphical statics.

From this we have the diagram wherein the load, "pull" and "push" are represented by lines drawn to a common scale. Then if the load line measures 10 in. long, by using the same scale to measure the "pull" line we find it to be 14.14 in. long and the "push" line to be 10 in. long. So it is evident that in order to lift this load with the chains in the position shown the chains must be capable of lifting 1.414 times the load and an even greater load if the angle is less.

The accompanying chart is intended to give the "pull" in the chain when working at various angles. In the column at the left we find the load to be lifted and at a point to the right on the line representing the angle of the chain, we find the "pull" in one side of the sling. For example let us suppose the load is 900 lb. and the chains make an angle of 45 deg. with the horizontal; then the "pull" will be 636.3 lb. in each chain instead of 450 lb. as might be expected and it will be necessary to use a chain to suit. If the angle is 30 deg. the "pull" in each chain will be 900 lb.

Gas Main Used as Tubular Girder for All-Welded Footbridge

TO SPAN a stream about 60 ft. wide in Australia an existing gas main has been used as a tubular girder to carry the decking and railing of a footbridge, as shown in the photograph. The bridge so constructed is 100 ft. overall, with a clear span of 50 ft. between supports. The main is 36 in. in diameter, of steel plate ⅜ in. thick. The height from the normal surface of the water to the gas main is 12 ft. The seams of the main are longitudinally welded and the joints are socketed and welded circumferentially.



ABUTMENT SUPPORTS AND SADDLES IN PLACE

The two steel frame supports at the abutments are entirely of welded construction, as are the cross bracing and attachments to the main. As no riveting was used, the main, of course, was not penetrated at any point. Shortly after completion the structure was subjected to heavy flooding and subsequent examination revealed no damage of any sort.

The bridge is located in a public park and is much used by pedestrians. The work was carried out by J. N. Reeson.

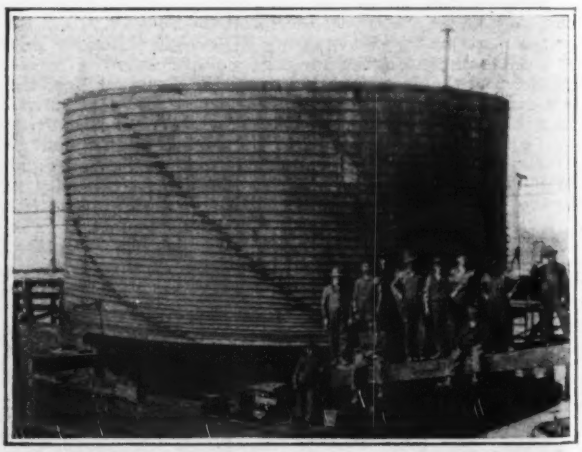
Moving Wood-Stave Tanks on Scow

By G. C. Grubb,
Assistant City Engineer, San Jose, California

DURING the past twelve years the writer has had considerable experience in the erection and installation of wood-stave tanks and pipe lines. This type of construction commends itself to him due to its relatively low cost, ease of installation, and long life.

The picture shows the method of handling large wood-stave tanks without "knocking down." The tanks have capacities of 2,000 and 1,000 bbl., and were used for the storage of fuel oil at Nanaimo, British Columbia. After they had been used at an industrial plant at that place for several years it was found necessary to move them to a new location about fifty miles away. After considerable discussion as to whether we would "knock them down" and ship them by rail or handle them without "knocking down" the latter scheme was decided upon. If successful, it of course would be the cheaper method.

The tanks in their original location were situated about 10 ft. from sea water at an elevation of about 3 ft. above high tide. The beach near the tanks was comparatively sandy, but had some bad boulders. There was a 10-ft. tide. It was decided to tow a large scow (about 40x80 ft.) to the water's edge at the site of the tanks at high tide, allow it to rest on the beach as tide went out, and load the tanks during the period between tides. In this way the elevation of the deck of the scow was only about 3 ft. above the bottom of the tanks and the loading could be carried on with the scow in a stable position. The loading of the tanks was successfully carried out between tides.



TANK OF 2,000-BBL. CAPACITY LOADED ON SCOW
Tank on rollers ready to be hauled up incline to new foundations.

From Job and Office

Hints that Cut Cost and Time

From Job and Office

For Contractor and Engineer

The scow was then towed to the new location of the tanks, and the latter unloaded between tides, only in this case the tanks were taken off at high tide, as the elevation of their new location was considerably above high water. After the tanks were set in place they were again put in use as fuel oil storage.

The work as above outlined was carried on with a crew of twelve men. Equipment used consisted in 12 by 12 timbers, 4-in. pipe rollers, three bottle jacks, a hand winch with ⅝-in. cable, and the necessary scow and tug. The writer was resident engineer in charge of the construction of a powder plant for the Canadian Explosives, Ltd., in connection with which the work was carried on. Wood-stave tanks and pipe lines were used extensively throughout the plant for different purposes.

Use of Quick-Setting Cement Allows Early Completion of Maryland Bridge

By B. T. Weston
Resident Engineer, Charles B. Hawley & Co., Washington, D. C.

QUICK-SETTING cement was used in the floor of the new highway bridge over Deep Creek near Oakland, Maryland, in order to allow the bridge to be opened for traffic as soon as possible after completion. This bridge was constructed to carry the Maryland state highway across the storage reservoir of the Youghiogheny Hydro-Electric Corporation, which is now constructing a dam and powerhouse in this vicinity. The opening of the bridge was essential to permit closure of the dam for storage of water and the use of alumina cement was adopted to expedite the completion of the concrete floor.

The bridge consists of two 300-ft. steel spans with 20-ft. roadway. It was fabricated and erected by the Bethlehem Steel Co. The first span was swung and concrete floor placed with portland cement Dec. 6, 1924, and the second span was swung on Jan. 7, 1925. Placing of concrete was immediately started using alumina cement in a 1:2:3½ mix with sand and crushed limestone, and continued in 10-hour day shifts until completed at 4:30 p.m. Jan. 9. The concrete comprised 165 cu.yd., 284 bbl. of cement being used. Protection of concrete at night was accomplished by spreading canvas over the concrete. Live steam was injected between the canvas and concrete. During the three days of the pour the following weather conditions prevailed: Jan 7, clear, maximum temperature 47, minimum temperature 12; Jan. 8, clear, maximum temperature 34, minimum temperature 11; Jan. 9, cloudy, maximum temperature 35, minimum temperature 14. Compression test samples taken during the pour showed an average of 2,001 lb. per square inch for 24 hours and 3,559 lb. for 7 days.

The floor of the bridge is 8½ in. thick at the crown and 7 in. at the gutter with wheel curb at each side, and was reinforced with ⅝-in. bars (as shown in the accompanying photograph) supported on bar chairs. Expansion joints of ½-in elastite were placed at panel points at about 38 ft. intervals and all pours were stopped at a joint

REINFORCING ON LUMNITE CONCRETE BRIDGE DECK

The inherent heat developed by the cement in setting made constant sprinkling necessary and aided materially in protection against frost. Forms were stripped after four days and traffic turned on the bridge Jan. 17, eight days after completion of the last pour.

This work was done by Charles B. Hawley & Co., Inc., of Washington, D. C., with B. T. Weston, resident engineer; Harry S. Thompson, field engineer; and Verne Clawson, superintendent.

Suspended Runway for Wheelbarrows Speeds Tunnel Mucking

IN THE Pit River No. 3 tunnel recently driven by the Pacific Gas & Electric Co. in Northern California (*Engineering News-Record*, July 31, 1924, p. 168) the movement of muck from the bench to the jumbo-bunker that closely followed the bench was greatly facilitated

RUNWAY SLUNG FROM TIMBER HOOKS, PIT RIVER TUNNEL

by the use of suspended runways. These runways consisted of 2-in. plank on 4x4-in. crossties supported by reinforcing bars bent as shown in the accompanying picture.

At the top these reinforcing bars were bent to pass through the chain of a pair of timber hooks sunk into the arch segment. These hooks were found to hold very satisfactorily and in fact were used quite generally on this job wherever it was necessary to sling weights from the roof timbers.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

In Defence of the Chicago Engineering Report

Sir—Recently there came to my attention the letter from Professor J. K. Finch published in your issue of February 26, 1925, p. 368. Anyone who reads Professor Finch's letter will, I think, form the opinion that he is making a labored argument against Chicago, be she right or wrong, and that he has entirely disregarded the constructive features of the report.

Dean E. E. Haskell, who was a member of the American section of the International Waterways Commission and who was eminently conversant with conditions leading to the boundary waters treaty of 1910, has stated to the writer that Lake Michigan is not and never has been considered as a boundary water and that the real reason for unequal division of permissible diversion for power at Niagara Falls was to provide temporarily for the generation in Canada of power to be used in the United States.

Professor Finch admits the truth of conclusion 61 of the Board of Review which, however, he slightly misquotes: "Furthermore, under present treaty restrictions, the water diverted at Chicago does not now and will not prevent the development of all the water power which it is possible to develop at Niagara by diversions now allowed by treaty." In the paragraph quoted, the Board of Review dealt clearly, exclusively and definitely with the treaty as it is. Professor Finch admits that paragraph 61 is true. Truth is not usually misleading nor is it so in this instance.

Professor Finch bases his argument on a pyramid of assumptions:

(1) That except for Chicago's diversion the treaty might have been different;

(2) That if more diversion had been allowed at Niagara Falls, more power would have been produced and that therefore there is

(3) A power loss in New York State and a consequent waste of coal.

Not one of these assumptions is justified, since it appears that it was not the diversion at Chicago which fixed or governed the amount of permissible diversion for power at Niagara Falls. Furthermore, only two-thirds of the power which it is possible to develop from water diverted at Niagara is now utilized but the full utilization of all the power is in no way hindered or interfered with by the Chicago diversion.

Paragraph 66 of the report of the Board of Review states: "There are no treaty restrictions as to the use of the St. Lawrence water for power, but less than 10 per cent of the available power is utilized. There will be no economic loss of power on either the Niagara or St. Lawrence River by reason of the diversion of water from Lake Michigan until 95 per cent of the available power at each location has been developed."

This again relates to present day conditions as to treaty restrictions at Niagara Falls. It is impossible to see how there ever will be any real economic loss at Niagara Falls, so far as power which can actually be utilized is concerned, if the quantity of water available is always as great as the amount permitted to be diverted for power under treaty restrictions, whatever they may be.

At the present time the Horseshoe Falls are rapidly undergoing self destruction. The Engineering Board of Review did not deal with questions of international law or diplomatic negotiation. If treaty modification is to be considered it should involve two factors other than an increase in the allowance of diversion for power at Niagara Falls. These factors are:

(1) Provision for restriction of flow through the V-notch in the Horseshoe Falls. This, according to the Warren report, would not only prevent further injury to the scenic beauty of the falls but would greatly improve present day conditions, reduce obscuration by mist and spray, increase the depth of overflow outside the V-notch and at the same time make it possible to divert at least 15,000 or 20,000 sec.-ft. additional for power.

(2) Provision should be made for regulation of lake levels. Such regulation would not only restore the loss of less than 6 in. due to the diversion by Chicago but it would restore the loss of 2.5 ft. additional in the levels of Lakes Michigan and Huron due to other causes. Besides these benefits the regulating works could be so constructed as to make it possible to further increase the diversion for power at Niagara by perhaps 20,000 sec.-ft. Until the economic losses of various kinds due to failure to carry out these projects have been eliminated, stoppage of diversion on the part of Chicago would merely have the effect of increasing instead of diminishing the waste of water at Niagara and the injury to Horseshoe Falls.

There is neither a "power loss" in the economic sense nor a "waste of coal" through the non use of water power which cannot be economically utilized. Talk about the "power loss" and "waste of coal" due to the diversion by Chicago has no meaning while the conditions described at Niagara Falls exist and while there still remain three million horsepower continually running to waste in the St. Lawrence River.

The Engineering Board of Review did not subordinate "other interests to those of their client," as Professor Finch wrongfully avers, but on the other hand the Board of Review did what none of the critics of Chicago seems to have done,—they advocated a constructive program for the utilization of the Great Lakes, including lake level regulation and restorative works at Niagara Falls which would confer much greater benefits on navigation and water power and on Niagara Falls than could be obtained by merely stopping diversion by the Sanitary District of Chicago. These are measures which should command the support of all fair-minded persons who really have the best interests of the Great Lakes region at heart.

Albany, N. Y., April 21, 1925. ROBERT E. HORTON
Consulting Hydraulic Engineer.

By Concussion or by Concatenation?

Sir—The letter in your issue of April 9, p. 614, entitled "Attacking Sewage Bacteria by Dynamite" recalls an incident that took place some years ago when Philadelphia was about starting a sewage testing station as a preliminary to preparing plans for sewage disposal. An old gentleman called on the chief engineer and remonstrated against any expenditure for a testing station since it was, he said, entirely unnecessary. "I understand that the trouble with sewage is the bugs, and that all that is needed is to kill the bugs; isn't that correct?" The chief intimated that it might be desirable to kill them. 'Well," said the old gentleman, "I can do it. All that is needed is to build a strong grating, pump the sewage violently against this grating, and kill the bugs, by concatenation—no expensive plants, no trouble, just kill 'em by concatenation, sir, by concatenation."

I can foresee that if the dynamite idea gains ground the country will be divided into two hostile sewage disposal factions, headed respectively by the Dynamite Trust and the Pump Trust, each extolling the virtues of its own method of sewage disposal, and incidentally extending the market for dynamite or for pumps, as the case may be.

Furthermore, just as in medicine we have two great schools, allopathic and homeopathic, we must expect that all sanitary engineers will in future have their shingles out as either "Concussionists" or "Concatenationists".

Philadelphia, Pa., April 20, 1925. MARSHALL R. PUGH.

Water Turned Into 13½-Mile Tunnel

Water from the upper San Joaquin River was turned into the 13½-mile Florence Lake Tunnel under Kaiser Range, Fresno County, California, on April 13. The tunnel is to divert the river into Hardington Lake, the reservoir at the head of the Big Creek-San Joaquin system of the Southern California Edison Co.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Only Rapid Transit Tunnel to Be Built at Narrows

New York City Ordered to Eliminate Combined Freight and Rapid Transit Features

In signing the so-called Nicoll-Hofstadter tunnel bill on April 12, Governor Smith, of New York, made effective a law requiring the city of New York to change the Narrows tunnel now under construction by the city as a freight and passenger tunnel to one "exclusively for purposes of a rapid transit railroad for the conveyance and transportation of persons." The Governor's signature was the end of a long controversy.

The Narrows tunnel was authorized by the Legislature of the State of New York in 1921 as a freight and passenger tunnel connecting the Borough of Brooklyn, Long Island, and the Borough of Richmond, Staten Island, and work has proceeded on that basis to the extent of some millions of dollars in the building of shafts on each side of the Narrows. Bids were to have been opened next month for the construction of the under-river tubes. The tunnel has been opposed by the Port Authority of New York which has in its Comprehensive Plan a freight tunnel across the upper bay some miles north of the Narrows tunnel and connecting New Jersey with Brooklyn without touching Staten Island. Further opposition arose in the Legislature last session to the expenditure of $60,000,000 on a freight and passenger tunnel, the argument being mainly that it was impossible to operate the tunnel satisfactorily as a joint freight and rapid transit scheme.

The city of New York has emphatically defended the necessity for the tunnel and the possibility of its successful operation for freight and passenger service. However, the Legislature passed the act in question and on April 20 the Governor had a hearing of both sides of the case. As a result of that hearing, he approved the bill and accompanying his approval with a long justification of his action.

His main contention is that the tunnel as devised by the city is obviously intended to take care of all of the freight which will go from New Jersey to Brooklyn and that therefore it would make unnecessary the Port Authority's tunnel which has been agreed upon in the treaty between the two states. He says, therefore, that if it is seriously contended that the Narrows tunnel is the proper freight connection between the East and West the way to bring it about is by amendment to the statute setting up the Comprehensive Plan between the States of New Jersey and New York and not by a competitive effort.

He states that he thinks that the weight of engineering opinion is in favor of the contention that it is not practical to operate rapid transit trains on the same tracks provided for freight and calls attention to the fact that the city is apparently confusing rapid transit service with ordinary passenger service. In this connection he suggests to the residents of Staten Island that they are themselves confused as to this distinction. What they need is rapid transit and not either freight or ordinary passenger service. There would be according to his advisors a saving of some $30,000,000 in building a rapid transit tunnel over what it would cost to build a combined tunnel. He further calls attention to the fact that the city has not been able to make any arrangements with any railroad for the use of the tunnel, which he considers to be an extremely unbusinesslike procedure. It is his opinion that the Baltimore & Ohio R.R., which is the only road now on Staten Island and therefore the one having commanding position as to the use of the tunnel, either will not use the tunnel or will use it at its own price and not at the price of the city.

In the interview immediately after the filing of the Governor's approval, Mayor Hylan, of New York City, stated that he would carry the case to the courts on the ground of a violation of the home-rule principle of the state law, but more recently he is reported to have abandoned that idea in favor of immediate construction of the rapid transit tunnel.

Engineering Fifty Years Ago

From *Engineering News*, April, 1875

FOR the past two years, 60 or 70 American locomotives a year have been sent abroad at an annual valuation of nearly a million of dollars.

A survey is going on to find the difference of level between the bed of the Red River above the raft and Trinity River of Texas near Gainsville, not far from the source. The object is to report upon the feasibility of turning the waters of the Red into the Trinity, with a view of improving the navigation of the latter and reclaiming the valley of the former from annual inundations by floods.

To License Engineers in Arkansas

The recently enacted Arkansas law requiring licenses for civil engineers practicing in that state becomes effective on June 11. Engineers now practicing will not be required to undergo an examination but must possess certain qualifications. Employees of public service corporations are exempt from the provisions of the law.

A. O. Backert Leading Technical Journalist Dies

A. O. Backert of Cleveland, Ohio, president of the Penton Publishing Co. and for a number of years on the editorial staff of *Iron Trade Review*, died April 24 at his home in Cleveland, at the age of 49 years. Mr. Backert was born in Cleveland and attended Western Reserve University. After some years of newspaper work he joined the staff of *Iron Trade Review* and *The Foundry*, with which he remained until 1906, when he became western editor of *Iron Age*. In 1908, however, he returned to *The Foundry*, of which he became editor, and *Iron Trade Review*, of which he was engineering editor. In 1913 he became vice-president and general manager of the Penton Publishing Co. and in 1924 its president. He was the editor of the "A-B-C of Iron and Steel" and a member of and contributor of papers to a number of technical associations.

An associate of Mr. Backert's has made the following comment on his life:

"His career was testimony of the opportunity for service open to the technical journalist. Never a producer or merchant of iron and steel products, he so saturated himself with the atmosphere of the business that for years he had been admitted to its inner circles as a valued advisor. He was not technically educated but he learned early in his editorial life the value of study of his specialty and he long since became known as an expert, not only in the business of iron and steel but also in its technology. In foundry practice especially he had for years been one of the leaders. In his later life when his administrative duties as head of a large publishing company made it impossible for him to continue close editorial contact with his field, he still retained the confidence of the industry and improved every occasion to capitalize that confidence in advice and suggestion to his editorial associates."

Auxiliary Water Tunnels to Cost $67,249,000 Proposed

The Board of Water Supply for the City of New York has presented to the Board of Estimate a proposal calling for the construction of an auxiliary system of water supply tunnels to supplement the existing tunnels and to safeguard the supply of Brooklyn and Queens. The plans call for a main tunnel 17 ft. in diameter through the greater part of its length, extending from the Hillview reservoir in Yonkers, through the Bronx and under the East River to Astoria, and then to Fort Greene Park in Brooklyn, at which point it would connect with the existing system. The Board of Estimate has adjourned for two weeks to consider the proposition.

City Building Officials Hold Active Meeting

Advocate Licensing—Building Codes and Zoning—Materials and Tests—Concrete Report

With building officials representing 76 cities of the United States and Canada, and with a total registration of 134, the eleventh annual meeting of the Building Officials' Conference, held at Madison, Wis., April 21 to 24, exceeded previous attendance records by more than 50 per cent. Although officials from the largest cities took active part in the proceedings, the problems of this organization are essentially those of the medium-sized city and of the large city that cannot be classed as a great city.

Placing responsibility for the safety of structures directly upon the architects and structural engineers who design them, was advocated in the report of the committee on Safe Construction, presented by William C. E. Becker, building commissioner, St. Louis. Licensing of architects and structural engineers was recommended; also that all structures except dwellings and certain other small buildings must be designed and supervised by a licensed architect or structural engineer. During the favorable discussion a resolution was passed advocating similar licensing for builders. A proposed building ordinance covering hollow masonry units, such as concrete block and clay or concrete building tile, was presented for the committee on Hollow Building Units by W. C. Muehlstein, building engineer for the Industrial Commission of Wisconsin. This ordinance follows closely the recommendations of the American Society for Testing Materials and the American Concrete Institute for clay units and concrete units respectively. In the discussion some speakers expressed doubt as to the need for the absorption test, holding that the strength test alone would be sufficient. Another proposed ordinance, presented for the committee on Stucco by Fred W. Lumis, inspector of buildings, Springfield, Mass., embodies knowledge obtained through recent experience and observation and through the extensive tests conducted by the U. S. Bureau of Standards.

A minority report advocated the licensing of contractors for exterior stucco work and interior plastering, under an arrangement similar to the plastering ordinance in force in Minneapolis, where the plan is in successful operation.

A committee report on building code requirements affecting limestone, presented by H. S. Brightly, of the Indiana Limestone Quarrymen's Association, covered details for anchoring this material where used as veneer and in lintels and cornices. Other committees presented progress reports on lime, walkway surfaces and sprinkler requirements. Fire tests on steel joist construction, now under way at the Underwriters' Laboratories in Chicago, were described in a paper by J. J. Calvin, Truscon Steel Co., but the tests do not yet permit forming conclusions.

The recent report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete was reviewed by Norman M. Stineman, Portland Cement Association, who contrasted it with the 1916 final report of the old joint committee. A point of particular interest to building officials was the disclosure that a committee of the American Concrete Institute is now preparing a proposed building regulation covering reinforced concrete, which will be based on the joint committee report but will be written in building code language. The discussion that followed touched the control of the quality of concrete under actual construction conditions and the methods followed in several cities to insure adequate inspection and supervision of important structures of all types of construction. There was also considerable discussion as to the legality of adopting the joint committee report by reference only, instead of reprinting it in a building code.

A paper on chimney construction, by D. Knickerbacker Boyd, of the structural service bureau, Philadelphia, brought out the fact that smoke leakage tests on recent residence chimneys indicated poor workmanship. The question of special interlocking chimney block drew the statement from Mr. Burton, building commissioner, Detroit, that a check extending over three years did not disclose a single chimney fire due to interlocking blocks. Compression tests on wall panels of clay, sand-lime and concrete brick, and of clay tile were reviewed in a paper by D. E. Parsons, U. S. Bureau of Standards. Comparative tests on panels 6 x 9 ft. indicated that walls laid in lime mortar and cement-lime mortar have about 40 and 80 per cent respectively of the strength of walls laid in cement mortar. These test walls were built so as to insure ordinary workmanship, bids being received and the contract awarded to the lowest bidder, who employed his regular workmen. The fact that the masons averaged from 1,200 to 1,400 bricks per day is a further indication that the workmanship was no better than ordinary.

Building Codes and City Zoning—Considerable time was given to papers on the arrangement of building codes and on zoning. These included "Advantages of an Appendix to a Building Code," W. O. Kirkpatrick, building inspector, Flint, Mich.; "Principles of Zoning," Robert Knight, deputy commissioner of buildings, Chicago; "Some Applications of Zoning," Rudolph P. Miller, consulting engineer, New York; "A Criticism of Building Code Arrangement," W. D. Guion, commissioner of buildings, Cleveland; and "Graphic Chart of Building Classifications," Edward C. Kerth, commissioner of buildings, Evansville, Ind. This chart shows the complete classification of buildings as regards use, occupancy, types of construction and zoning restrictions. In most codes the subject matter of this chart covers many pages of print, whereas the chart covers only one sheet of ordinary page size. As to the size of building codes, it appears that the U. S. Department of Commerce will recommend 5 x 7 in. as the most convenient coat-pocket size. The new codes of Flint, Mich., and Evansville, Ind., were mentioned as model codes for medium-sized cities, as regards both arrangement and subject matter. The discussion disclosed several recent state supreme court decisions and one in the U. S. Supreme Court in favor of zoning laws.

Papers presented at a session at the U. S. Forest Products Laboratory included "American Lumber Standards," Carlisle P. Winslow, director of the laboratory; "Dry-Rot in Mill Constructed Buildings," H. E. Plummer, inspector of buildings, Portland, Ore.; "Strength of Timber," John A. Newlin, Forest Products Laboratory; "Lumber Conditions Under Present Practice," P. J. Reville, superintendent of buildings, Borough of Bronx, New York City; and "Nature of Decay in Timber," C. J. Humphrey, U. S. Bureau of Plant Industry. Mr. Humphrey described in detail the various kinds of fungi, giving particular attention to so-called southern dry-rot, the most difficult of all to control because of the waterbearing strands that penetrate timber to great lengths. He stated that the southern states east of the Mississippi and the Pacific Northwest are the regions most subject to dry-rot, because the temperature and moisture conditions are favorable to the growth of fungi.

Officers elected include: President, Frank Burton, building commissioner, Detroit; vice-president, H. E. Plummer, inspector of buildings, Portland, Ore.; secretary, J. F. Downey, building inspector, Cambridge, Mass. New standing committees include one on unit working stresses and another on publicity.

Hughes to Represent New York State on Water Power

Former Secretary of State Charles E. Hughes has been retained as counsel to protect New York State's water-power rights against the encroachment of the federal government. In announcing the retention of Mr. Hughes, the Attorney General said: "The scope of the question involved is far greater than the contention of the State of New York. The issue presents timely opportunity to fight for the preservation of state rights as against the steady encroachment and centralization of power in the federal government—a contest which will enlist the united sympathy of all the states."

British Exhibition at London

Announcement is made that the British Empire Exhibition held in London in 1924 is to be renewed this year, and will be a point of interest to engineers. The Palace of Engineering and Palace of Industry will again be special features of technical interest, and a special exhibit of modern housing is to be made, under the direction of the Minister of Health. Industries and natural resources of the several British colonies and commonwealths will be largely represented. The exhibition will be open from May to October.

International and National City Planning Conferences

The International Federation for Town and Country Planning and Garden Cities, which met in New York City last week, re-elected as president, Ebenezer Howard, of London. As chairman of the executive council, to succeed George B. Ford, New York City, the conference chose Dr. R. Schmidt, planning director of the Ruhr District, Essen, Germany. The honorary secretary is C. B. Purdom, executive of Welwyn Garden City, England, and the honorary treasurer, Dr. Raymond Unwin, chief architect, British Ministry of Health, London. Among the vice-presidents elected is F. A. Delano, chairman New York Regional Plan Committee, New York City. The next annual conference will be held in Vienna, Austria, in 1918.

The national Conference on City Planning elected John Nolen, Cambridge, Mass., as president, Edward M. Bassett, New York City, as vice-president, and continued Flavel Shurtleff, New York City, as secretary.

Some fifty foreign delegates to last week's conference began a tour of American and Canadian cities on April 27, at Washington, from which they were to go to Baltimore, Philadelphia, Pittsburgh, Chicago, Detroit, Buffalo, Niagara Falls, Toronto and Montreal, sailing from Montreal for Europe on May 9.

The proceedings of the two conferences are reported at length elsewhere in this issue.

Municipal Improvement Meeting to Be Held in Des Moines

The annual meeting of the American Society for Municipal Improvements will be held in Des Moines, Iowa, Oct. 26-29. The program for the meeting has not been completed. It will be announced at a later date.

New Jersey State Water Policy Commission

A New Jersey State Water Policy Commission to consider the proposed Tri-State Delaware River Water Treaty and "to formulate a comprehensive state water policy for the timely development of sources of water supply," and for financing such a development was created by the 1925 session of the state legislature. Among the seven members of the Commission named in the resolution is Carrol P. H. Bassett, of Summit, N. J., formerly a consulting engineer for municipal work and for many years president of the Commonwealth Water Co. of Summit. The Commission is authorized to employ engineering and other assistants, has been given an appropriation of $20,000, and is to report to the legislature of 1926, "with drafts of bills to effectuate its recommendations."

Contractors May Sue Utah State Road Commission

A bill which makes it possible for contractors to sue the State Road Commission of Utah under its written contract has been passed by both houses and signed by the Governor. The bill does away with arbitrary decisions of resident and other engineers in charge of state road construction. The contractors of Utah expect that now this bill has become law the commission will work out a satisfactory arbitration arrangement with them.

Another bill in the Utah Legislature sponsored by the Utah Manufacturers Association and which provided that convicts from the state prison should be used as labor in constructing all public roads in the state was defeated in the State Senate. The manufacturers association objected to convicts being used on the manufacture of overalls and other clothing, and sought to have them used on state roads.

Franklin Institute Honors Noted Engineer

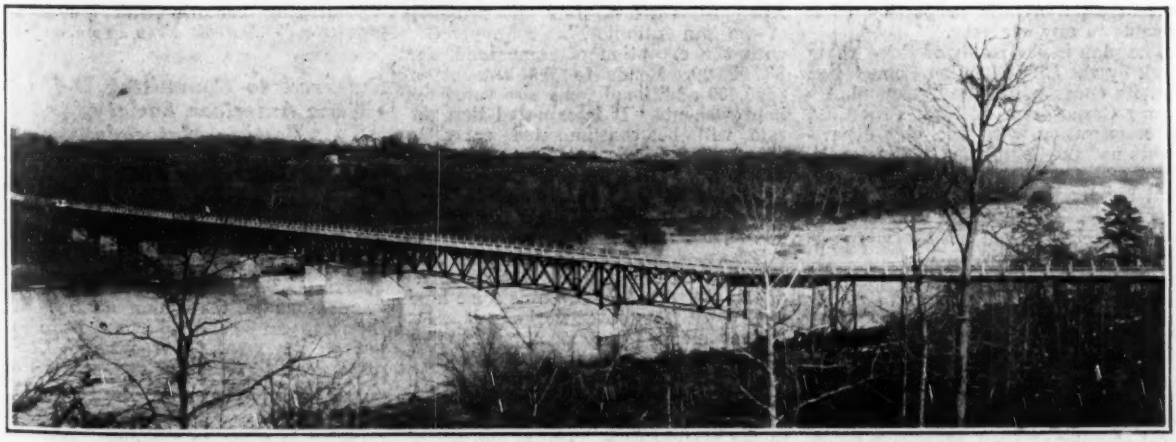
Francis Hodgkinson, chief engineer of the South Philadelphia Works of the Westinghouse Electric & Manufacturing Co., has been presented with the Elliott Cresson Medal, one of the highest honors conferred by the Franklin Institute, in recognition of his achievements in the field of steam turbine design and construction during the past 30-1 years. The presentation was made by Dr. William C. L. Eglin, president of Franklin Institute, at its regular meeting on April 15.

Mr. Hodgkinson, who was born in England, received his primary education at the Royal Naval School at New Cross. In 1885, he joined C. A. Parsons & Co., the English turbine engine concern, where, with the exception of four years spent in the Chilean Navy and later with a mining company in Peru, he remained until 1896. At that time he took charge of the engineering and designing work on the Parsons type turbines for the Westinghouse company, which had previously secured the American rights for their manufacture. Mr. Hodgkinson has been chief engineer of the South Philadelphia Works since 1916.

Subjects for Track Meeting

Five subjects have been selected for committee reports at the annual meeting of the Roadmasters & Maintenance-of-Way Association to be held at Kansas City, Mo., in September: (1) Programming section work, (2) inspecting and identifying ties for renewal (3) means of prolonging life of rails, (4) methods and cost of weeding track, (5) roadmasters' responsibilities for proper relations between the railways and the public. T. F. Donahoe, general supervisor, B. & O. R.R., Pittsburgh, Pa., is secretary of the Roadmasters & Maintenance-of-way Association.

Toll Bridge Across James River at Richmond Opened to Traffic



The structure pictured above, which spans the James River near the westerly limits of the city of Richmond, Va., is 2,035 ft. long. The bridge is 28 ft. wide, which width includes two 4-ft. sidewalks. The structure is a toll bridge and is known as the Boulevard Bridge, owned by a corporation of that name. The floor is 120 ft. above normal water level. The bridge, in the main, was designed and erected by the Atlantic Bridge Co., though that part in a park at one end was designed and built by E. T. D. Myers, president of the corporation owning the structure. The typical river spans are 172 ft. long and approach spans from 30 to 85½ ft. The bridge was opened Jan. 1, 1925.

U. S. Delegation Named to Attend International Building Industry

The United States will be represented at the Fourth International Congress of the Building Industry and Public Works, which will meet in Paris, June 15, by the following delegation appointed by the Secretary of State:

I. N. Haughton, president of the Elevator & Machine Co., Toledo, Ohio.

John W. Harris, treasurer of the Hegeman-Harris Co., New York City.

William Doyle, of Doyle & Co., Builders of Philadelphia.

Walter Snow, secretary-treasurer, International Elevator Constructors.

Noble Foster Hoggson, New York City, an authority on apprenticeship training, improvement of housing, and stabilization of employment in the building industry.

Walter Stabler, Comptroller, Metropolitan Life Insurance Co., New York City.

Gen. R. C. Marshall, Jr., general manager, Associated General Contractors of America, Washington, D. C.

Eugene C. Lewis, Detroit House Financing Corporation.

J. C. Nichols, Investment Co., and developer country clubs and recreational centers, Kansas City, Mo.

Comprehensive City Plan Adopted by Cincinnati, Ohio

What is declared to be the first complete city plan to be adopted by any of the larger cities of the country was officially adopted by Cincinnati, Ohio, on April 16. It includes not only the city but the areas three miles outside it also. Hereafter there can be no use of private property contrary to the zoning and planning regulations of the plan and no streets, public buildings, or public utilities contrary to the plan can be officially located except by a two-thirds vote of the City Council after public hearings, and with the approval of the department affected.

The cost of executing the plan is to be distributed over 50 years with no more than a normal proportion of it payable in any one year.

The plan is the result of three years work by the City Planning Commission and its consultants, the Technical Advisory Corporation of New York City, in co-operation with the city departments and public utilities of Cincinnati. The studies were initiated and largely paid for by the United City Planning Committee, composed of some thirty leading organizations of the city.

Summer Courses at Carnegie

The Carnegie Institute of Technology, Pittsburgh, has announced that it will give summer courses from six to eight weeks beginning June 15 for undergraduates and those in engineering work who feel the need of more technical training in their respective fields. The College of Engineering will give courses in chemistry, physics, mechanics, engineering drawing, descriptive geometry, and surveying. A special short course in coal mining will be given in co-operation with the U. S. Bureau of Mines.

Sacramento River to Be Deepened, $3,000,000 Bonds Voted

A bond issue of $3,000,000 for dredging the Sacramento River between San Francisco bay and the city of Stockton, Calif., was carried by a majority of 12 to 1 in that city on April 21. According to press reports, 65 per cent of the registered voters participated in the election.

This bond issue is in accord with the scheme of improvement outlined in *Engineering News-Record*, Feb. 26, p. 372, and proposes a channel 26 ft. deep with a bottom width of 100 ft.

Keystone Co. Starts Work on Philadelphia Subway

After a delay of some weeks in the award of the contract for the construction of a portion of the Broad St. Subway in Philadelphia, Pa., due to litigation, the contract which was awarded to the Keystone State Construction Co. has been signed and actual construction was started at Broad and Arch Sts. on April 28. Details of the suit were given in *Engineering News-Record* March 26, p. 537, April 2, p. 573, April 16, p. 667 and April 23, p. 707.

Railway Extension for Washington

A 14-mile extension of the Cowlitz, Chehalis & Cascade Ry. southeast from its terminal at Lacamas has been approved by the Interstate Commerce Commission. Its estimated construction cost of $386,680 is to be met by an issue of bonds, which will be taken by the four trunk railroads connecting with the C., C. & C. Ry., the present length of which is 24 miles. W. E. Brown is president and general manager; R. W. Sweet, chief engineer.

Water-Works of San Antonio Bought by City

The voters of San Antonio, Tex., on April 18, voted to buy the property of the San Antonio Water Supply Co., with the exception of some land, for $6,500,000. Bonds to the amount of $500,000 additional were also voted for improvements. It is expected that the sale will be consummated early in May. The sale is made through Natt Wagner, of the First National Co., of St. Louis, Mo., who buys the stock of the company as of Jan. 1, 1925, for $6,706,000, assuming all the liabilities and agrees to sell the assets of the company to the city for $6,500,000 as of the same date, but retains some land not used for water-works purposes. Improvements to the plant made since Jan. 1 are to be paid for by the city out of the $500,000 of additional bonds voted. The earnings from Jan. 1 to the date of transfer of the property go to the stockholders. The $6,500,000 of bonds to be issued by the city to pay for the property will bear 5½ per cent interest.

Robert J. Harding, who has been vice-president and general manager of the San Antonio Water Supply Co. since 1913, will sever his connections with the water-works plant when the transfer is made to the city. During the negotiations between the company and the city the company has been served by Allen Hazen, New York City, as consulting engineer, and the city has been represented from time to time by Alexander Potter, consulting engineer, also of New York City.

Random Lines

This Current Puzzle Craze

Three pieces of mail lie open on our desk. On the engraved face of the first, Aloysius X. Scrumple "announces the opening of his office at 609 Fidelity Building for the general and consulting practice of engineering." The second is the program of the annual meeting of the Associated Advertising Clubs of the World at the Rice Hotel. The third is an elaborate advertisement for bids on some roads by the "State Highway Department." Offhand there may not seem anything worthy of comment in these three notices, or anything of similarity. But there is. Mr. Scrumple's card nowhere reveals the name of the city where he practices; our flamboyant advertising confréres evidently believe that every one knows in what city is the Rice Hotel and the highway department is so proud of the state it represents that it does not feel the necessity of mentioning it in its literature. It has been said that the ultimate pinnacle of fame is to be known merely by one's last name—Cæsar, Bonaparte, Hoover, for instance. But isn't is presuming a bit for a consulting engineer, a bunch of advertising men and a highway department gratuitously to assume a similar prominence?

* * *

The Glorified Ice Man

"How would you like to be a cryogenic engineer? Never heard of such an occupation? You probably profited by the services of one at your dinner today. Without him fresh meat and vegetables would be unknown in many places and at many seasons, and would be much more expensive, for all city dwellers at least.

"Perhaps you would know the job a little better under its more common name of refrigeration engineer. His is the skill that preserves eggs, poultry, dressed beef, fish, fruits and everything else, where preservation depends upon discouraging bacteria with low temperatures."—*Detroit Free Press.*

* * *

Referred to Committee D-4, of the American Society for Testing Materials.

In moving to accept the bid of the Iron Trap Rock Co., Alderman Sylvestre said: "Within the last two years there has been a lot of talk about the stone of the Iron Trap Rock and Quinn. I think the Mayor went to visit both quarries. The Mayor even chewed up some stone of the Quinn quarry. If the stone can be chewed it isn't fit to be put on the street."—Woonsocket Correspondence, Providence *Journal.*

Engineering Societies

Calendar

Annual Meetings

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Louisville, Ky., April 27 to May 2, 1925.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Convention, Chicago, May 12-14, 1925.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Convention, Orlando, Fla., June 2-5, 1925.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Meeting, Union College, Schenectady, N. Y., June 17-20, 1925.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 22-26, 1925.

The Wisconsin Section of the American Water Works Association will meet May 27 and 28 at Madison. On one day a joint meeting will be held with the Wisconsin Municipalities League.

Personal Notes

JACK RAPIER has been appointed city engineer of Hermosa Beach, Calif., succeeding H. R. TAYLOR, who resigned recently.

E. H. ALDRICH, city engineer of Wisconsin Rapids, Wis., has resigned, effective May 1.

JOHN L. BACON, present mayor of San Diego, Calif., and an engineer, has been re-elected for his third consecutive term.

BENJAMIN BEAN is now chief draftsman with the St. Louis Structural Steel Co., of East St. Louis, Ill., in their plant office. Mr. Bean was with the Horen's Structural Steel Co. in Kansas City, Mo., for some time as designer and checker, and went to East St. Louis in January as squad boss and checker with the St. Louis Structural Steel Co.

A. C. LAGERWALL, for the past five years county engineer of Shawnee County, Kansas, has resigned, effective June 1. Mr. Lagerwall's previous work was as resident engineer for Douglas County on federal aid work.

GEORGE B. FARLOW, assistant engineer, Pittsburgh Division, Baltimore & Ohio Railroad Co., with headquarters at Pittsburgh, Pa., was promoted to division engineer, Charleston Division, headquarters at Weston, W. Va. THEODORE BLOSCHER, Jr., assistant engineer, office of the chief engineer of maintenance, of the same company, was promoted to division engineer, Wheeling Division, headquarters at Wheeling, W. Va. J. L. MAHER, division engineer, Charleston Division, headquarters at Weston, W. Va., was transferred to Monongah Division, headquarters at Grafton, W. Va.

MAJOR JAMES W. BAGLEY, Corps of Engineers, has been placed on special duty with the Air Service for the purpose of experimenting with photographic instruments used in mapping by airplane.

MAJOR W. J. POWELL, who has been chief engineer to the supervisor of public utilities, Dallas, Texas, for the past four years, has resigned and has opened an office for the practice of civil engineering in that city. Previous to his service with the supervisor, Major Powell was county engineer of Dallas County. During the War, Major Powell served with the Engineering Corps in France.

W. R. ARMSTRONG, assistant chief engineer, Oregon Short Line R.R., Union Pacific System, has been appointed general superintendent of the Los Angeles & Salt Lake R.R., a part of the same system. B. H. PRATER, engineer, maintenance of way, succeeds Mr. Armstrong as assistant chief engineer of the Oregon Short Line, F. D. NAUMAN, division engineer, succeeds Mr. Prater, and L. W. ALTHOF, assistant engineer, succeeds Mr. Nauman.

JOSEPH A. WISE, instructor in structural engineering at the University of Minnesota, has been appointed to the corps of civil engineers, U. S. Navy, ranked as lieutenant, junior grade, with orders to report to Washington, April 20. Mr. Wise is a graduate of the University of California and was formerly with the U. S. Bureau of Public Roads. He has been doing part time work on the co-operative drain tile investigation at University Farm, Minn., for some months.

O. J. EIDMANN has been appointed engineer of design for the Kansas Highway Commission. Mr. Eidmann, a graduate of the University of Missouri, served as resident engineer for the Illinois Highway Commission for three years, then as assistant bridge engineer for the Kansas Highway Commission for four years; for the past two years he has been senior member of the consulting firm of Eidmann & Marshall.

COL. FRANK C. JONAH, chief engineer of the St. Louis-San Francisco Ry., has received the Polish decoration, the Order of the Swords of Haller, "in commemoration of his faithful service to the fatherland in France and in Poland, 1918-1920." Colonel Jonah went to France with the 12th Engineers and after serving with that regiment for two months on light railways behind the British front was detached and assigned to the General Staff. It was during the latter period that he rendered the service to Poland for which the decoration was awarded.

WILLIAM N. BROWNLIE has joined Stone & Webster, Inc., as engineer in the electrical division at their Boston office. During the War Mr. Brownlie served with the Royal Engineers of the British Forces. For three years following the war he was with The British Thomson Houston Co., Ltd., and the past two years has been in South Africa on engineering and construction projects, having most recently been engaged in technical and sales duties with R. L. Weir & Co., representing Seimens, Ltd.

Obituary

BAURAT GOTTLIEB THEODOR HOECH died recently at Kolberg, Germany, aged 74 years. He will be remembered by many American engineers in this country as the technical attaché to the German Embassy twenty years ago.

JAMES E. BRADY, for many years in the employ of John H. McGowan Co., manufacturers of pumping machinery, Cincinnati, died on April 10. He was a special representative of the hydraulic department of Allis-Chalmers Manufacturing Co., for four years and had a wide acquaintance in engineering machinery circles.

WILLIAM R. RONEY, mechanical engineer and inventor of smoke-consuming furnaces used extensively in industrial and electrical power plants, died at Downers Grove, Ill., April 6. Mr. Roney was for several years connected with the Westinghouse Electric & Manufacturing Co. in regard to steam powerplant developments.

CHARLES O. POOLE, who has been identified with hydroelectric construction in California for twenty-five years, died in southern California April 2 at the age of 66. He was born in Salisbury, Mass., but went to the Pacific Coast to take up engineering work in 1884. In 1900 he had charge of construction on the first high-tension transmission line built into San Francisco. In 1904 he became chief engineer of the Southern Sierras Power Co., which position he retained until last year when he resigned to become consulting engineer to the company.

M. J. DEGNON, well-known as a contractor on the Williamsburg bridge over the East River at New York City and the Cape Cod Canal, died April 21 at his home in Kew Gardens, Queens, Long Island, aged 67 years. Mr. Degnon was born in Cleveland, Ohio, and received his education and entered the contracting business there. In 1897 he went to New York and developed the construction enterprise of which he was head, as president of the Degnon Contracting Co., the Degnon Realty and Terminal Improvement Co., the Degnon Terminal Railroad Corp., and other concerns; during a long period of activity he built bridges and subways, railroads and terminals. Much of the original Interborough subway was his work, and later subway extensions. Mr. Degnon was one of the leading developers of Long Island City and was in great measure responsible for having the B. M. T. tunnel extended thereto, across the East River from 60th St., Manhattan. His last significant achievement was the reclamation of the section of land lying between Corona and Flushing, Long Island.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Electric Drive for Power Shovels

Improvements in Design Account for Growing Use of Electrically Operated Machines

By D. J. Shelton
Assistant Chief Engineer, Marion Steam Shovel Co.

and D. Stoetzel
Industrial Engineering Department, General Electric Co.

(Abstract of a paper presented at the meeting of the American Institute of Electrical Engineers in St. Louis, April 15.)

THE attitude of owners and operators toward the electric shovel has been going through a transition. Heretofore, the electric shovel was installed more or less as an experiment. Now the indications are that the day is not far distant when the purchaser of a power shovel will regard the electric machine as a standard and logical application. There is no record of any electric shovel being replaced by a steam machine as a result of poor performance.

Cost Comparisons with Steam Machines

The electric shovel always has, and probably always will, carry a higher initial cost than the steam machine. The reason for the comparatively high price of the electric shovel is due to several factors. In the first place, the number of mechanical parts is increased by the larger gear ratios between the motors and shovel motions. Secondly, a stronger shovel is necessary for electric drive since the range of adjustment in the equipment permits greater torque and pulls than are possible with steam drive. Finally, the electric equipment itself is usually of a special nature and, therefore, is not built in such quantities that production savings result. However, the higher first cost can practically always be justified when operating expense and output are considered.

The question of operating economy concerns itself chiefly with a comparison of power costs, labor costs, and maintenance costs. Coal delivered at the shovel is usually expensive, and its conversion into mechanical energy with the limited boiler equipment and reciprocating steam engines is an inefficient process. On the other hand, the central station not only gets its fuel at the best possible rate but also obtains much more actual working energy from a pound of coal than it is possible for the steam machine to deliver. The labor cost for an electric shovel is less than for a steam shovel due to the elimination of the fireman, the pit gang man who maintains the coal and water supply, and the watchman who is usually required to keep the fires over night. The steam shovel is always at the mercy of the water supply in the locality in which it operates. The big item of maintenance on a steam shovel is the boiler. Cleaning is often necessary two or three times per week and inefficiency of operation frequently results from "foaming boiler," loss of pressure, etc.

With the majority of operators, output or yardage is the first consideration. Continuity of service is the all-convincing argument for the electric shovel. It is not uncommon to see a steam shovel shut down in order that a stuffing box may be tightened or because of a fault in the water system or for coaling up. On electric machines most of the shut downs are due to failures of some of the smaller apparatus such as contactors. Where efficient operators capable of looking after the equipment are provided the electric shovel shows much the better efficiency. Records show that, considering an average, the repairs on electric machines are approximately 18 per cent less than on steam machines.

As to the comparison of working time percentages, very careful investigations have been made of this phase of the problem and it has been found that conditions greatly affect this. For instance, three years ago I personally checked two steam shovels and one electric machine which were stripping in the same pit. One steam machine was working two ten-hour shifts and the other, one ten-hour shift, while the electric shovel was working one ten-hour shift. This steam machine which was working two ten-hour shifts operated during a greater percentage of the available working time than the steam machine which was operating one ten-hour shift. Both machine were operating during the winter and there was a loss of from 30 minutes to one hour, night and morning in draining pipes and making provision either for shutting down during the night or for starting up in the morning. On the electric shovel, of course, it was only necessary to start the motor-generator and go to work.

The electric shovel on this job lost about 20 per cent time, the steam machine which was operating double shift lost 28 per cent time and the steam machine which was operating single shift lost approximately 37 per cent time. There was, of course, a certain amount of time lost due to moving up, greasing, etc.

Leaving the comparison of electric and steam machines with the advantages of lower cost of operation and increased output in favor of the electric machine, the various types of electrical equipment available for shovel drive may be considered.

Types of Electric Equipment Used

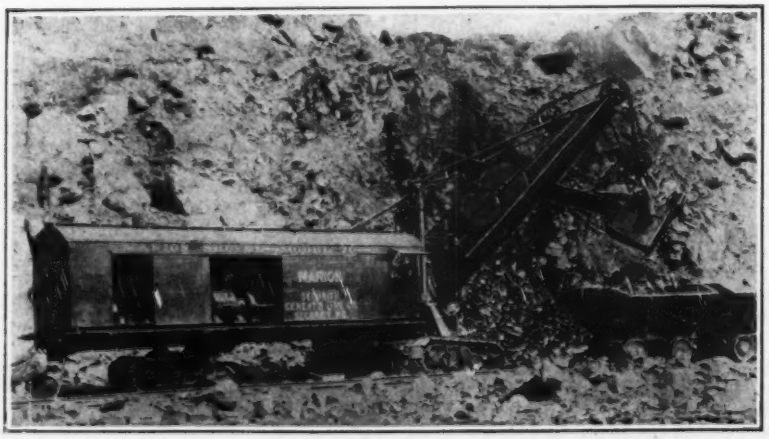
Shovels are divided into various classes according to their construction, size, or motive power:

1. *Small revolving* shovels run up to 50 or 60 tons total weight ready for work, with dipper capacities of ¾ to 1¾ cu.yd.

2. *Railroad type* shovels run up to 110 tons working weight, with dipper capacities of ¾ to 6 cu.yd.

3. *Large revolving* shovels run from 100 to 400 tons working weight, with dipper capacities of 3 to 8 cu.yd.

Shovels may be further classified into (1) friction drive machines, and (2) individual motored machines. Friction drive machines utilize a single motor, running at constant speed and operating continuously; their power is transmitted to the various motions of the shovels by means of gears and clutches. These machines use a standard squirrel cage induction motor with hand compensator or a standard d.c. motor with hand starter, and are seldom rated over 75 hp. This form of drive cannot be used with success on large machines in view of the amount of power to be transmitted. In order to secure proper control, flexibility, and speed of operation, individual motored machines were developed utilizing separate motor for hoisting, for crowding, and



A 3½-YD. SHOVEL WITH VOLTAGE-CONTROLLED GENERATORS

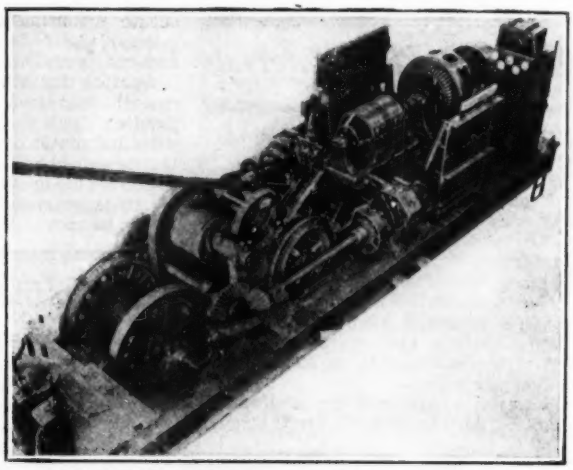
for rotating. Drum type controllers are necessary on account of space limitations, and the motors must be of special type to insure the necessary qualities of strength and durability. The resistors designed for starting and speed regulating duty must be of suitable quality to withstand the severe vibration.

In the majority of cases, the power supply to the shovel will be alternating current. For reasons which are to be brought out in the following discussion, it is desirable to use a motor generator for converting to direct current to allow this form of power to be used. While it is impossible to secure all the advantages of the full voltage control type of equipment on a single generator installation, it has been found of great advantage on small shovels to use a type of generator having a decided drooping volt-ampere characteristic, with no-load voltage higher than normal and voltage at maximum load as low as possible. This amplifies the desirable characteristics of the series motors, produces a faster shovel, and at the same time, tends to reduce the power peaks and the strains and stresses on the mechanical parts. In other words, even though direct current is available at the shovel, it is advisable to interpose a motor-generator on account of the superior operating characteristics produced by the drooping generator characteristics. The larger type shovels use individual generators with special characteristics for each motion.

Shovel Auxiliaries

There are certain special features of the electrical equipment for shovels which are best described as auxiliaries. Revolving shovels with electric drive are nearly always one-man operated, while similar steam machines have two-man control. It is always necessary to have two men operate the railroad type shovel, whether steam or electric, because the dipper does not stay in the same position relative to the operator during swinging. This necessitates a shovel operator who is responsible for the hoisting and swinging motions, and a craneman who operates the crowding and the dipper trip rope. The dipper trip is a mechanism or latch which permits the bottom of the bucket to open, thus depositing the load. On revolving electric shovels this operation is accomplished by means of a small motor which is arranged to wind up the dipper trip rope. This motor is controlled by a push button or latch on one of the controllers, which controls a contactor short-circuiting a section of resistance in the motor circuit. The motor is normally across the line with a large amount of resistance in circuit. The object is to keep the dipper trip rope free from slack for all positions of the dipper. This motor-operated dipper trip feature, together with a foot-operated drum controller for one of the three motions, usually the rotating, makes the large electric revolving shovel a good one-man proposition.

Other advantages and refinements common to both types of electric shovels include traction motors; the use, in the case of large crawler-mounted shovels, of motors for steering, which slew the rear set of crawlers; air operated, spring-set brakes on all motions controlled by magnetically operated valves; and regenerative braking to lower the empty dipper on the large revolving shovels. The question of using a.c. or d.c. motors for shovel drive has always received serious consideration. A.c. motors have a lower first cost but their operating characteristics are much inferior to those of the d.c. motor. At the present time, more than 90 per cent of the installations are of the d.c. type. A comparison of the advantages of each type is summarized as follows:



ELECTRIC SHOVEL WITH HOUSING REMOVED
Note that the synchronous motor and three generators are located at the rear, as is the boiler on the steam machine.

ADVANTAGES OF D.C.

1. Lower power consumption.
2. Power factor correction and lower power peaks resulting in:
   a. Lower power costs.
   b. Saving in transmission lines.
   c. Saving in transformer capacity required.
3. All parts of the equipment of sturdy and reliable construction—contactors and relays eliminated.
4. Equipment very flexible and easily controlled resulting in:
   a. Efficient operation.
   b. Increased production.
   c. Less abuse of mechanical parts.
5. The power of the driving motor is applied to the mechanical parts smoothly and continuously and the equipment is relieved of the shocks and strains which are unavoidable with the induction motor drive. This results in:
   a. Longer life of mechanical parts.
   b. Lower maintenance cost.
   c. Fewer interruptions and consequently increased production.

ADVANTAGES OF A.C.

1. Lower first cost.
2. Fewer rotating parts.
3. Control system more familiar to average operator: i.e., theoretically simpler.
4. No standby losses from motor-generator while waiting for cars, etc.
5. Power supply to motors is 440 volts instead of 2,200 or 4,000 volts as to the synchronous motor on the d.c. equipment.

The desirable operating characteristics of the steam machine which are imitated to a certain extent in the d.c. motors are stalling under heavy overloads, and running speeds higher than normal under light loads. The voltage control type of equipment permits creeping speeds for inspection and oiling of moving parts which are impossible with any rheostatic type of control.

The advantages of the d.c. equipment as regards power supply and construction are quite marked provided the shovel is kept busy. Due to the generator characteristics producing low voltage at high current and high voltage at light load, the power peaks will be much lower than is possible for a constant voltage system producing the same maximum torque. A.c. equipment is more appreciably affected by subnormal voltage than is d.c. equipment. D.c. motors are of rugged construction, and the windings are simple and of large cross-section copper.

In the last analysis, however, it is operating results that count. It is extremely difficult to get real comparative data on the operation of both types. They are seldom found on the same property and, therefore, when they are compared one advocate will say the conditions of operation are vastly different. Fortunately, however, there are a few places where the conditions cannot be questioned. One large company operating both types is making all replacements with d.c. equipment. In such cases the electric shovel must have proved its superiority.

Conclusion

While the foregoing indicates clearly that the authors of this paper feel that d.c. variable voltage control is the ideal equipment at the present stage of the art, at the same time it must not be overlooked that under certain conditions, shovels equipped with a.c. motors have operated with a fair degree of success. With alternating current there is no necessity for motor-generators for the conversion to d.c., although, as pointed out previously, their use is desirable.

The superior operating characteristics of the d.c. equipment, however, are becoming quite generally recognized both on the part of the shovel builder and large operating companies whose engineers have had the oportunities for close first hand study of both types of equipment.

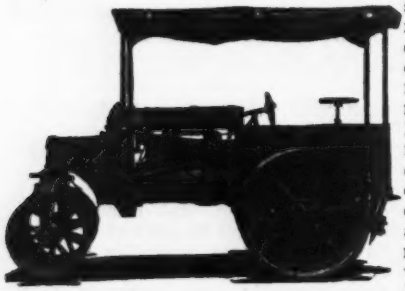
Although the availability of power supply has heretofore been of some weight in choosing between steam and electric equipment, the tremendous recent growth in the number of central stations has assured an ample and dependable supply of power at a reasonable price. Furthermore, although steam equipment still predominates, shovel electrification is coming rapidly to the fore as indicated by the number of large operating companies making or seriously considering the change from steam to electric drive.

Equipment and Materials

Roller Makes One-Man Job of Highway Maintenance Work

A one-man gasoline roller for highway maintenance is the 5-ton Pony unit made by the Acme Road Machinery Co., Frankfort, N. Y. The machine has a planer attachment in front and scarifier attachment at the rear, and with its three rollers is adaptable for scarifying, leveling and rolling old roads and in the preparation of subgrade on new construction.

Power is furnished by a Fordson tractor. All the controls for the roller

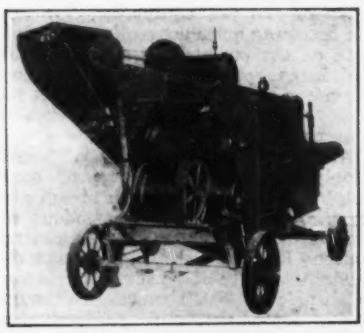


and the attachments are within easy reach of the operator. The planer attachment, individually controlled by the operator, can be adjusted to any position. Material can be scraped to either right or left, or the planer can be set at an angle for trimming shoulders. By the use of an extension the blade can be made to reach the toe of the slope for cleaning ditches.

Refinements in Mixer Design Reduce Vibration

Improvements in concrete mixers to eliminate vibration have been made by the Lansing Co., Lansing, Mich., in its 7-S and 14-S mixers. This has been accomplished by lowering the center of gravity, the machines being designed so that they hang low to the ground. In order to insure rigidity the frame is hot riveted and amply cross-membered.

On these new models the design and arrangement of the blades and buckets



gives a thorough mix and fast discharge action, and smoothness of action in this part of the machine is accomplished by machining of the drum tracks to perfect circles, and by accurate mounting of the drum on the rollers, the rollers on the trunnions and the trunnion shafts on the frame.

Another feature that lends itself to smooth operation is the internal expanding Raybestos-lined hoisting clutch with automatic release and brake when the skip reaches the 50 deg. discharging angle. The operation of the hoisting clutch is so smooth that the skip can easily be moved with one hand.

Business Notes

PITTSBURGH PIPING AND EQUIPMENT Co. and AMERICAN FOUNDRY AND CONSTRUCTION Co. announce their consolidation, the object of which is to strengthen their position as the leading fabricators of power piping in the country. The officials of the former company will be connected with the new organization. The combined business will be operated as the Pittsburgh Piping & Equipment Co., occupying its new plant in Pittsburgh and the fabrication of all materials will be carried on in this plant. The officials of the company will be as follows: President and general manager, George H. Danner; vice-president, Morgan B. Schiller; vice-president and treasurer, Chas. R. Rall; secretary, W. R. Neely; general manager of sales, Robert Whyte; assistant secretary, Louis K. Hamilton; manager of purchases, Karl F. Tiegel. The present district offices of this company in Pittsburgh, Cleveland, New York, Chicago, Indianapolis, and San Francisco will be maintained.

BROWNING Co., Cleveland, Ohio, announces a change in its corporate name to The Browning Crane Co.

Publications from the Construction Industry

Shoring—H. W. ROOS Co., Cincinnati, Ohio, publishes a 32-page booklet, handsomely illustrated, printed on calendered paper, on the Rooshor Shoring apparatus. It is pointed out how their use will eliminate the waste entailed in cutting lumber for each shoring job, besides the saving from the fact that the shores can be used over and over again.

Brick Roads — NATIONAL PAVING BRICK MANUFACTURERS ASSOCIATION, Cleveland, Ohio, has just issued three booklets, "Brick Pavements," "Making Brick Pavement," and "Brick Roads Outlast the Bonds." Pictures illustrate the piont made in the booklets that roads paved with brick are the most economical in the long run.

Flue and Flue Linings — EASTERN CLAY PRODUCTS ASSOCIATION, Philadelphia, has issued a 32-p. publication entitled "Flues and Flue Linings, With Related Data on Chimneys and Fireplaces." Included in its contents are drawings and tables of the recently adopted standard sizes of round and rectangular fire-clay flue linings which also give the "effective" areas of rectangular linings and data on the proper and safe construction of chimneys and fireplaces.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Construction in First Quarter of 1925 Compared with First and Last Quarters of 1924

Increase In Actual Physical Volume Due to Lower Cost—Gains In Public Works and Commercial Buildings Since First of Year

The unprecedented volume of lettings since the first of the year and the particularly high value of those in the first part of April are due largely to the confidence felt in the comparative stability of present prices. Materials stocks are plentiful and production is being controlled. Another factor is the satisfactory labor situation.

Costs over the first three months of 1925 were 6 per cent lower than in the same period of 1924 and very slightly under those of October, November and December. Total contract values in the first quarter were about six millions less than a year ago, but the actual physical volume of work is 2 per cent greater owing to lower costs.

The decline in value was particularly severe in industrial building. Declines were registered also for roads, federal government work and unclassified construction. These losses were offset by increases in public works and

GEOGRAPHIC DISTRIBUTION OF CONTRACT VALUES AS REPORTED BY *ENGINEERING NEWS-RECORD* IN THE FIRST QUARTERS OF 1924 AND 1925 AND IN THE LAST QUARTER OF 1924

	1st Quarter 1925 (000) omitted	1st Quarter 1924 (000) omitted	1925 Difference Per Cent	4th Quarter 1924 (000) omitted	1925 Difference Per Cent
New England	$43,807	$36,056	+22	$39,376	+13
Middle Atlantic	149,655	162,293	— 7	149,200	...
Southern	44,849	56,580	—23	32,975	+36
Middle West	71,271	83,244	—15	94,382	—25
West of Mississippi	92,714	71,380	+30	82,754	+12
Far West	68,215	66,597	+2.6	62,710	+ 8
Total	$470,511	$476,150	— 1	$461,397	+ 2

commercial buildings. Geographically the declines occurred in the South, the Middle West, and the Middle Atlantic States. The gains were in New England and West of the Mississippi.

Engineering News-Record's indexes compare the three periods thus:

E. N.-R.	1st Quarter 1925	1st Quarter 1924	4th Quarter 1924
Cost Index	207.81	222.16	208.22
Volume Index	150	142	147

Activity in industrial building in the same periods is shown by the following index number (1913-100) for that class alone: 1st quarter 1925—187; 1st quarter 1924—293; 4th quarter 1924—226.

The following tabulations present contract conditions by classes of work and by sections of the country:

In these contracts, minimum costs are the same as those mentioned in the column to the right.

VALUE OF CONTRACTS REPORTED BY *ENGINEERING NEWS-RECORD* IN THE VARIOUS CLASSES OF CONSTRUCTION IN THE FIRST QUARTERS OF 1924 AND 1925 AND IN THE LAST QUARTER OF 1924

	1st Quarter 1925 (000) omitted	1st Quarter 1924 (000) omitted	1925 Difference	4th Quarter 1924 (000) omitted	1925 Difference
Water-Works	$14,992	$11,360	+36	$10,434	+43
Sewers	14,492	11,697	+17	20,556	−30
Bridges	14,733	13,278	+15	9,438	+56
Excavation	3,152	4,443	−25	7,424	−57
Sts. & Rds.	68,206	76,856	−12	66,461	+3
Industrial Bldgs.	40,540	67,713	−40	49,007	−17
Commercial Bldgs.	279,200	250,563	+11	231,817	+20
Federal Gov't.	7,384	8,530	−13	8,805	−16
Unclassified	27,812	31,710	−12	57,455	−51
Total	$470,511	$476,150	−1	$461,397	+2
Index Number (1913=100)	150	142		147	

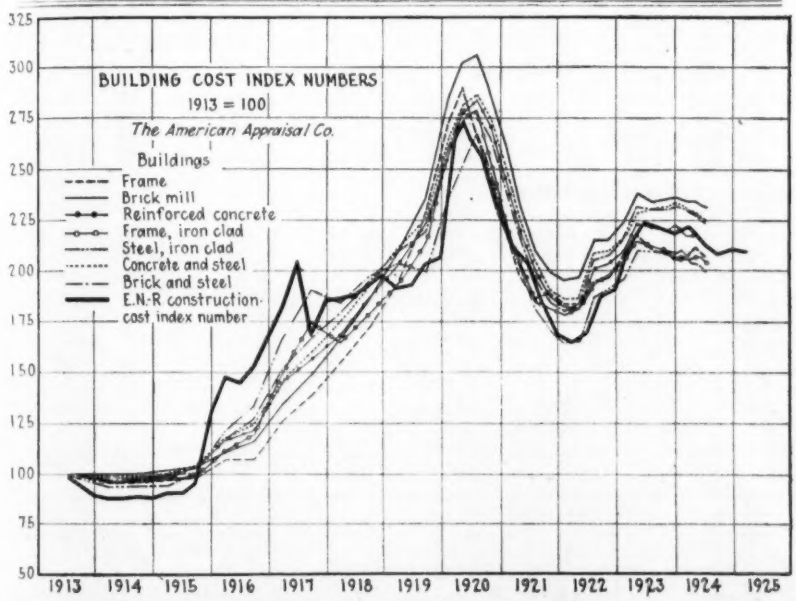


FIG. 1—INDEX NUMBERS SHOWING COST OF VARIOUS TYPES OF BUILDINGS COMPARED WITH GENERAL CONSTRUCTION COST

This Week's Contracts—Week Ago—Same Week Last Year

The money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks.

Minimum costs observed are: $15,000 for waterworks and excavations, $25,000 for other public works, $40,000 for industrial and $150,000 for commercial buildings.

MONEY VALUE OF CONTRACTS LET—ENTIRE U. S.

Week Ending	Public Work	Private Work	Total Contracts
Apr. 30, 1925	$34,981,000	$13,255,000	$48,236,000
Apr. 23, 1925	22,676,000	31,108,000	53,784,000
Apr. 30, 1924	23,838,000	20,548,000	44,386,000
Heaviest Week			
1924, May 8	26,370,000	38,829,000	65,199,000
1925, Apr. 2	43,603,000	27,633,000	71,236,000
Jan. 1 to Date			
1925	313,453,000	413,151,000	726,604,000
1924	300,517,000	384,113,000	684,630,000

"E. N.-R." Cost Index and the Cost of Buildings

Comparison Also Shown with Materials Costs and Those of Other Elements of Property Value

Index numbers prepared by the American Appraisal Co. of Milwaukee, showing relative costs of seven different types of construction as well as prices of eight materials or elements of property value, are here compared with the *Engineering News-Record* Construction Cost Index Number.

The similarity in trend is apparent; the idea being to show cost of all construction for the entire country, compared with that of specific buildings and also materials from which they were constructed, in certain geographic sections.

The *E. N.-R.* Index is designed to show general construction cost and consists of four basic elements, namely: steel, lumber, cement and labor. Fluctuations in these factors are nationwide in scope and are affected but slightly by local conditions.

The index numbers of building costs, worked out by the Appraisal Company

(*Continued on p. 752*)

March Exports Show Better Conditions Abroad

Washington Correspondence

Exports in March were larger than in any month in four years, with the exceptions of October and November, 1924. In only one month in four years have the imports exceeded those of March.

A significant point is that the major increase appears to be in partially manufactured goods, which is proof of better conditions abroad. Increased imports of raw materials indicates improving business at home.

Our foreign trade, when the depreciation of the dollar's buying power is taken into consideration, is fifty per cent greater than during the fiscal year of 1913-1914. No other country has made any such showing.

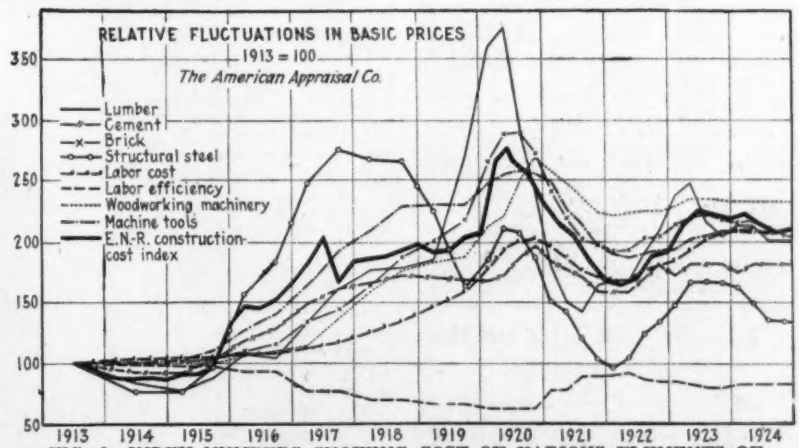


FIG. 2—INDEX NUMBERS SHOWING COST OF VARIOUS ELEMENTS OF PROPERTY VALUE COMPARED WITH GENERAL CONSTRUCTION COST

Weekly Construction Market

RESTRICTION of production to a degree consistent with current demand, appears to be the prevailing practice in most of the basic industries of the country. It is apparently a condition where the output has been checked, while consumption continues at an active pace.

Engineering construction is at least 6 per cent ahead of a year ago this time, while cost is about 6 per cent lower. Although materials prices have been on the decline lately, slight increases in wages of skilled labor or maintenance of the old schedules have kept general construction cost from dropping abruptly.

Latest reports of structural steel bookings show gain. Lumber production is heavier. Railroads continue to purchase equipment in large volume. The American Locomotive Co. reports, as of April 10, orders for forty-four locomotives. Twenty of these are for the Seaboard Air Line, twenty-one for the Florida East Coast R.R. and three for the Detroit and Toledo Shore Line.

Industrial factors, not directly connected with construction, show the following signs of improvement: Stronger prices for securities; firmness of money market; activity in retail trade; record freight loadings, increased bank debits; high rate of output in automotive industry; acceleration in production of agricultural implements, refractories and paper.

There is depression, however, in the coal mining industry; irregularity in the textile market; lack of any notable activity in leather and slowing down in operations of cotton spindles.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb	$3.34	$3.90	$4.15	$3.10	$3.35	$3.07½	$3.30	$3.35	$4.25
Structural rivets, 100 lb	4.50	4.45	4.75	3.50	3.75	4.65	5.00	3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb	3.24	3.40	3.38	—2.60	3.25	3.87½	3.35	3.25	2.30
Steel pipe, black, 3½ to 6 in. lap, discount	48%	53.2%	43%	56½%	54.25%	36%	40.6@52.1%	50%	59.49
Cast-iron pipe, 6 in. and over, ton	52.60@53.60	55.00	56.00	46.70@48.20	53.00	62.00	55.00	55.00	60.00
Concreting Material									
Cement without bags, bbl	2.50@2.60	2.30	2.05	2.20	2.42	2.84	2.31	2.65	1.80
Gravel, ¾ in., cu.yd	1.75	1.90	2.38	2.75	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd	1.00	1.40	2.00	2.75	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.85	2.00	2.83	2.75	—1.65	2.50	2.15	3.00	1.90
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	58.00	35.00	56.00	29.00@39.00	39.75	34.75	27.00	23.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	+20.00	+20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.50@2.75	1.45	1.85	1.21	1.35	2.70	1.60	2.80	9.50
Common brick, delivered, 1,000	17.00	10.50	+12.10	12.00	13.50@13.60	12.00	15.50	+15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.0808	.0941	.06	.07	.085	.....	—.10	.12
Hollow partition tile 4x12x12, per block	.1162	.0808	.0941	.06	.....	.085	.108	—.10	.10
Linseed oil, raw, 5 bbl. lots, gal	1.09	1.15	+1.30	+1.26	1.18	1.30	1.20	1.12	1.11
Common Labor									
Common labor, union, hour	.75	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	25	30@.50	.75	.50@.55	.35@.50	.50	.50	20@.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 50c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of April 2, the next on May 7.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at par). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

"E. N.-R." Cost Index and the Cost of Buildings

(*Concluded from p. 751*)

(Fig. 1), are based on 1913 as 100 and represents re-priced buildings in Eastern cities only. The following types are used: Frame, brick (mill), reinforced concrete, frame (iron clad), steel (iron-clad), concrete and steel, and brick and steel.

The numbers shown in Fig. 2 are also based on 1913 as 100 and include the following: Lumber, structural sizes, Southern yellow pine, f.o.b. mill; cement, f.o.b. Buffington, Ind., mill.; brick, common, delivered, average of twenty-four ctites; structural steel, f.o.b. Pittsburgh; labor cost, building trades, average of twenty-four cities; labor efficiency in the building trades; woodworking machinery; and machine tools.

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